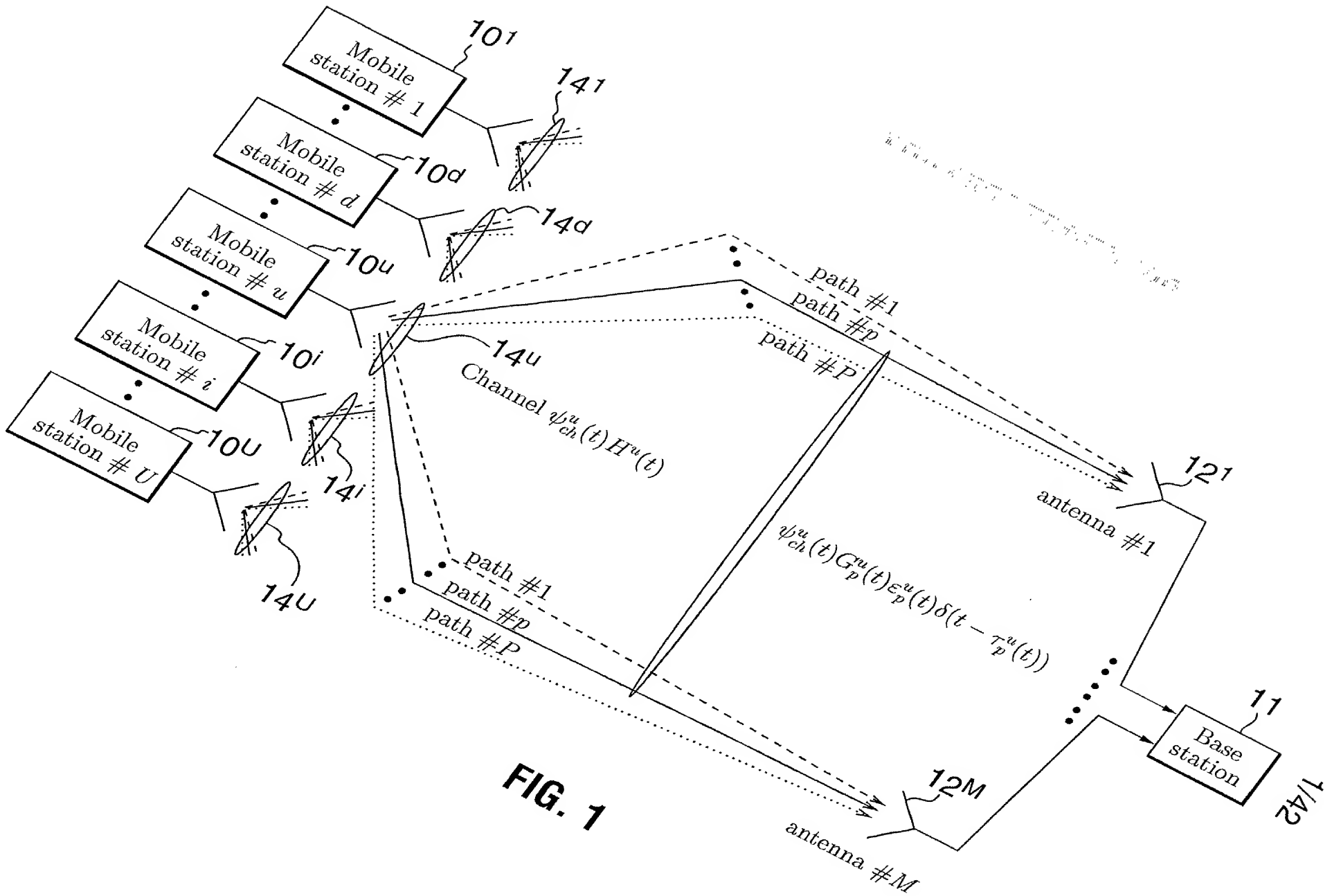

Mobile station # 1
Mobile station # d
Mobile station # u
Mobile station # i
Mobile station # U
10 1
10 d
10 u
10 i
10 U
14 1
14 d
14 u
14 i
14 U
path #1
path #p
path #P
Channel $\psi^u_{ch}(t)H^u(t)$
$\psi^u_{ch}(t)G^{nu}_p(t)\varepsilon^u_p(t)\delta(t-\tau^u_p(t))$
12 1
12 M
antenna #1
antenna #M
11
Base station

FIG. 1

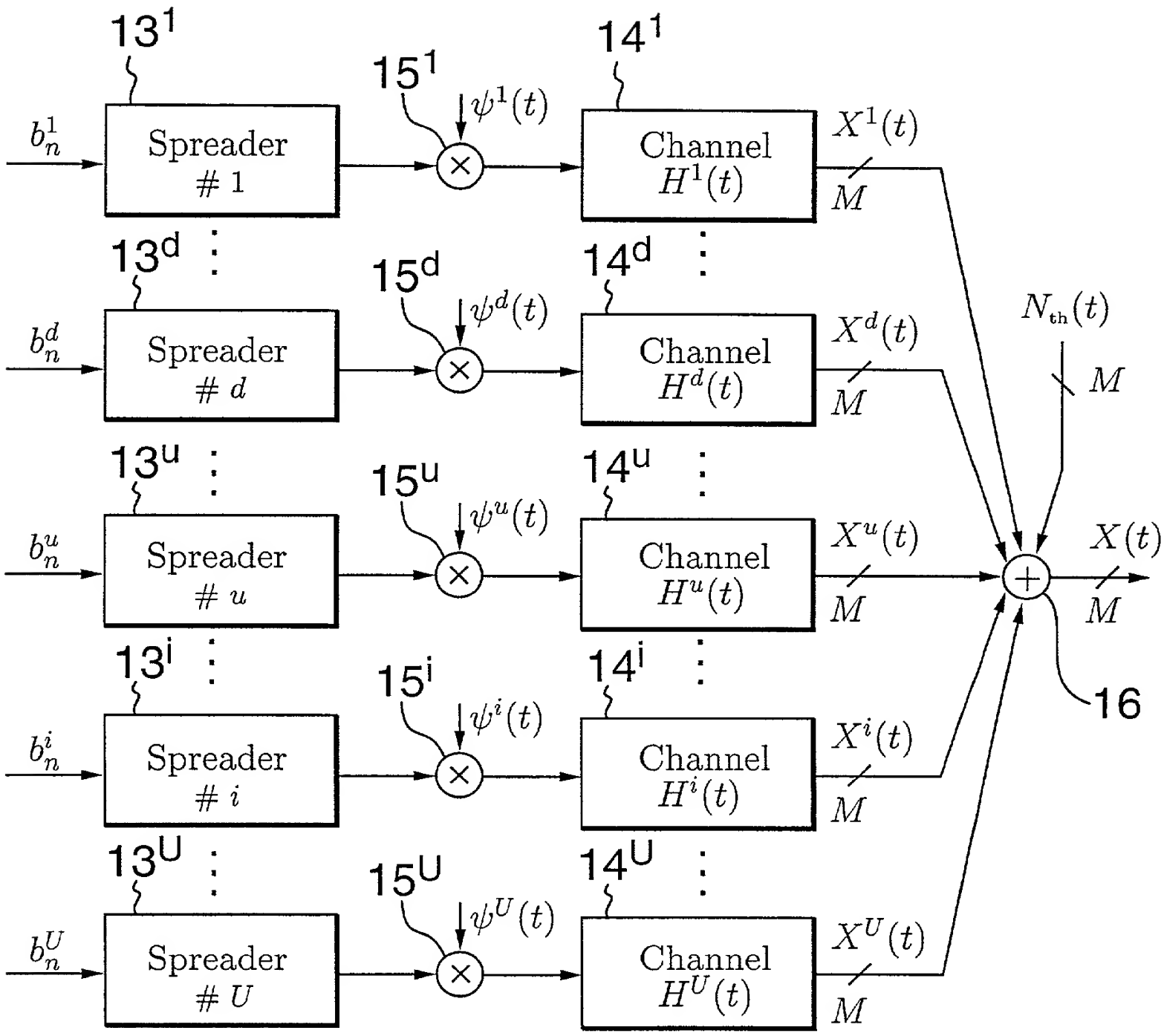

13^1
15^1
14^1
b_n^1
Spreader # 1
$\psi^1(t)$
Channel $H^1(t)$
$X^1(t)$
M
13^d
15^d
14^d
b_n^d
Spreader # d
$\psi^d(t)$
Channel $H^d(t)$
$X^d(t)$
M
$N_{th}(t)$
M
13^u
15^u
14^u
b_n^u
Spreader # u
$\psi^u(t)$
Channel $H^u(t)$
$X^u(t)$
M
$X(t)$
M
16
13^i
15^i
14^i
b_n^i
Spreader # i
$\psi^i(t)$
Channel $H^i(t)$
$X^i(t)$
M
13^U
15^U
14^U
b_n^U
Spreader # U
$\psi^U(t)$
Channel $H^U(t)$
$X^U(t)$
M

FIG. 2

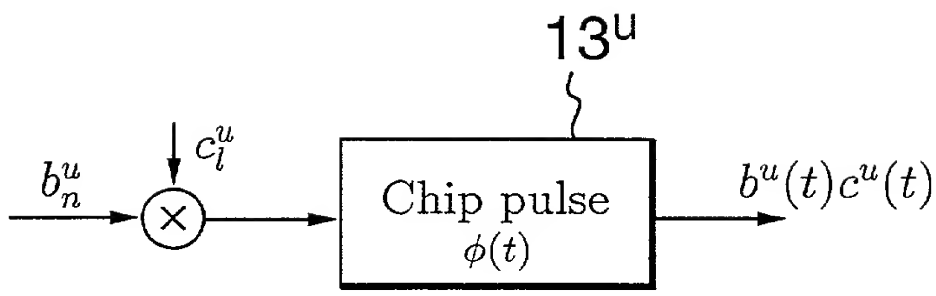


FIG. 3

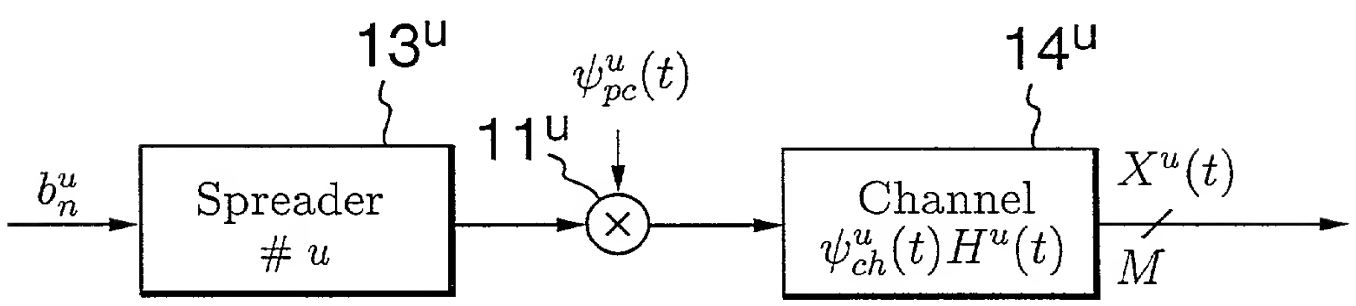


FIG. 4(a)

≡

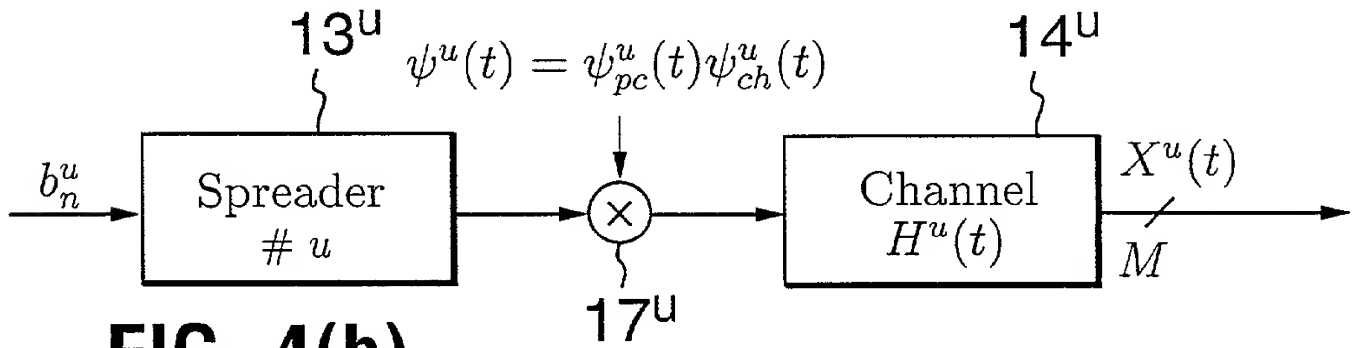


FIG. 4(b)

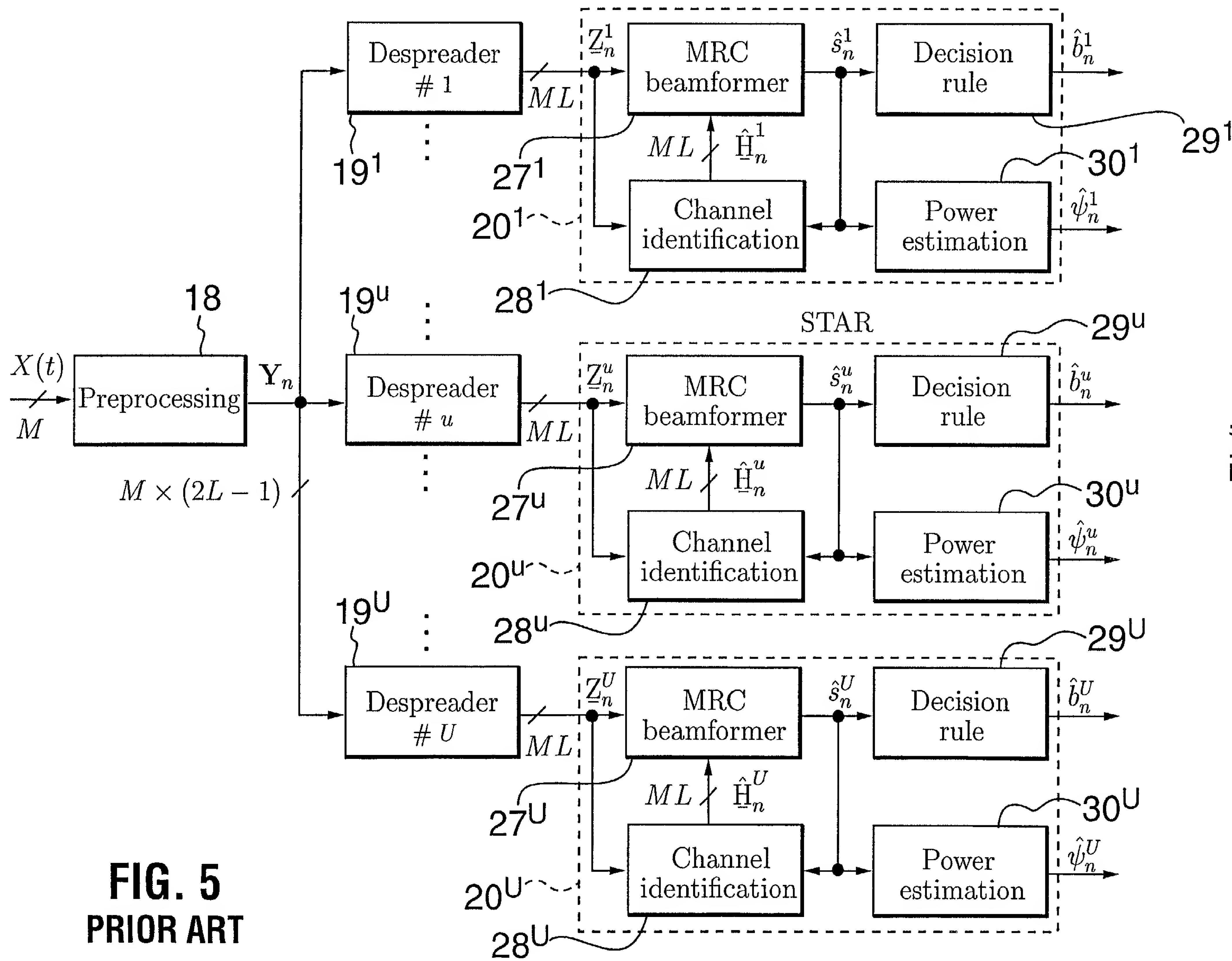


FIG. 5
PRIOR ART

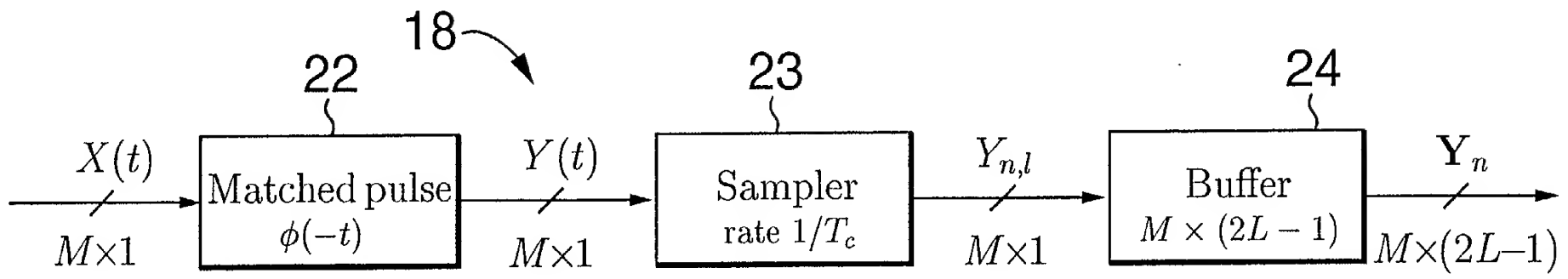


FIG. 6

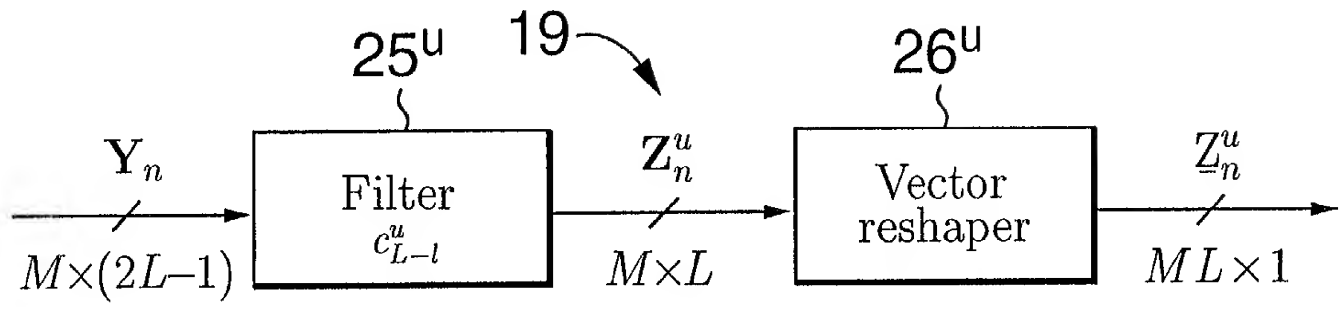


FIG. 7

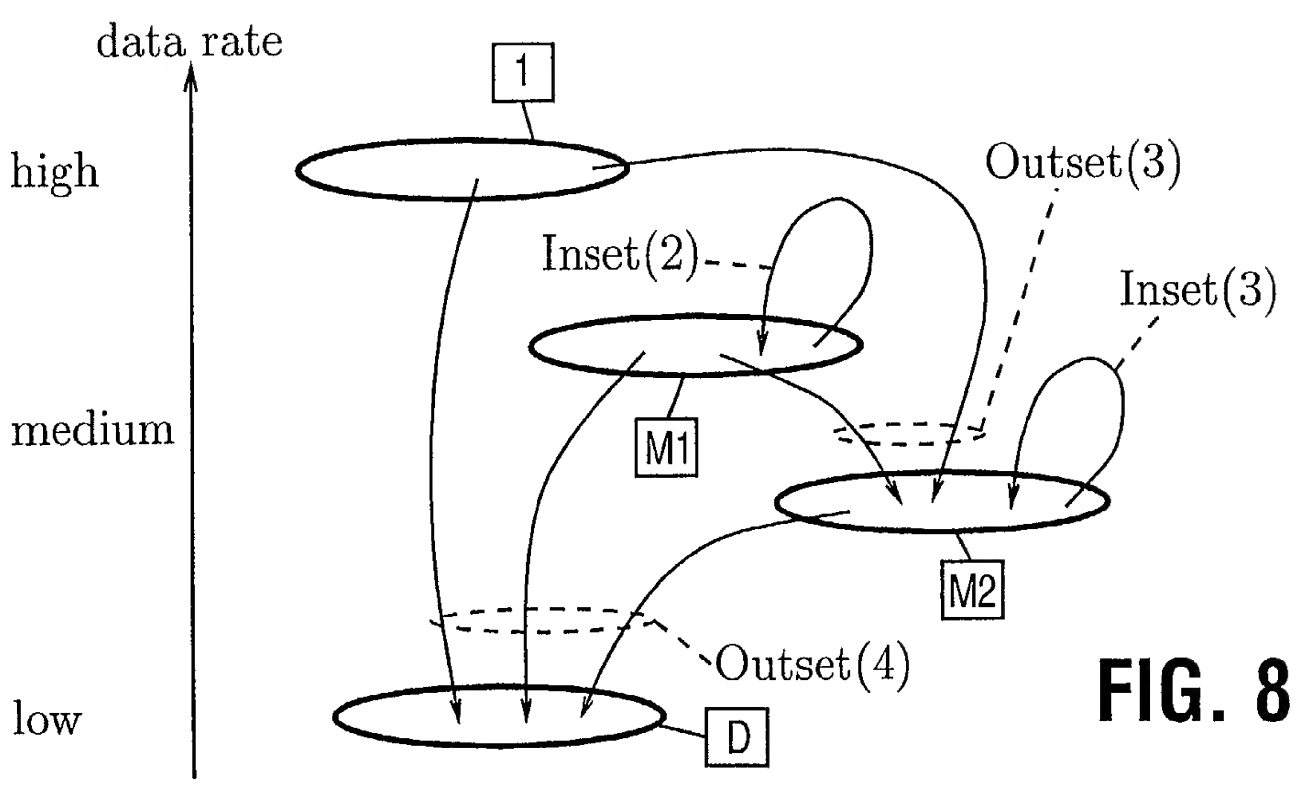


FIG. 8

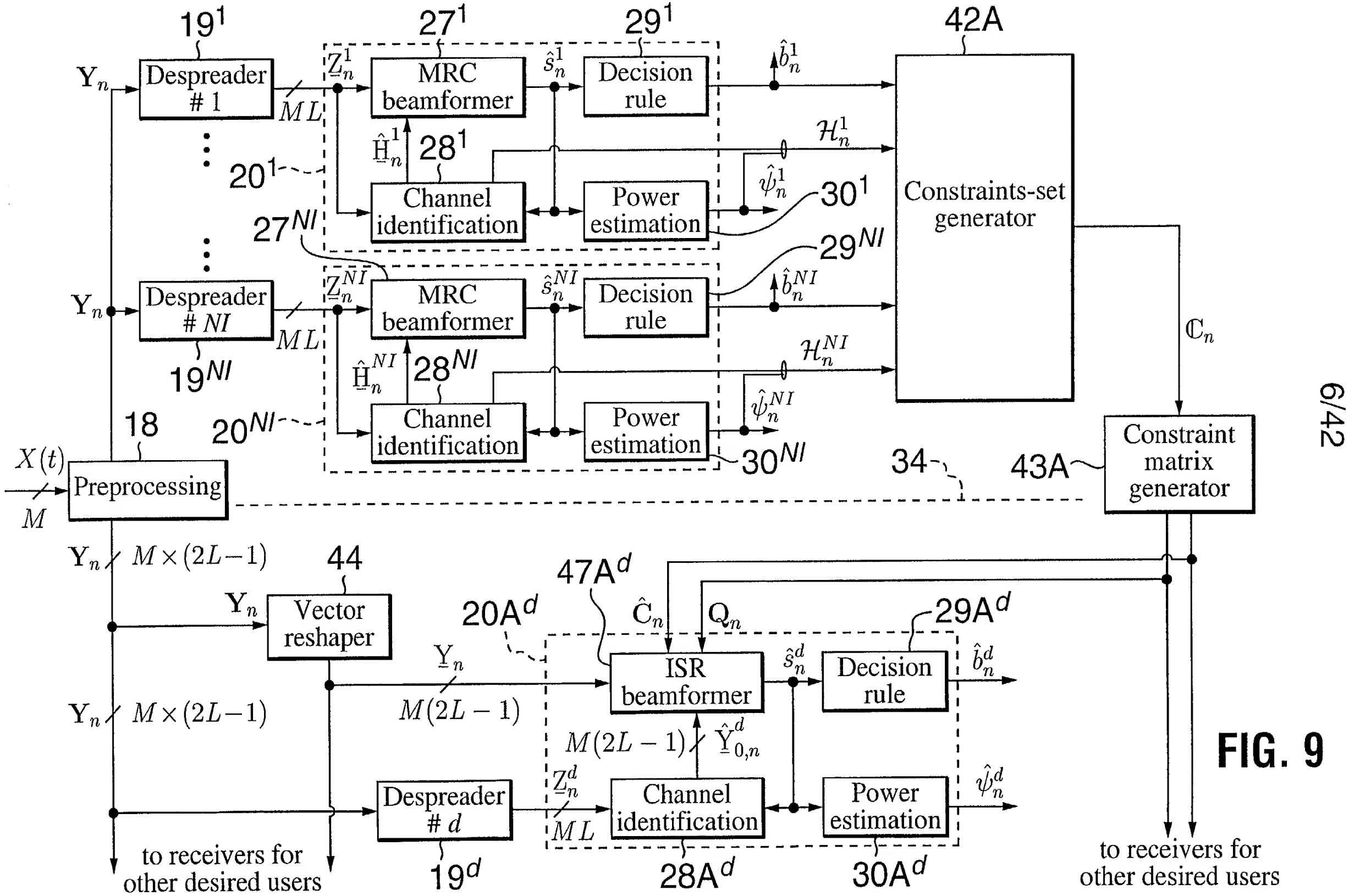

19^1
27^1
29^1
42A
Despreader # 1
MRC beamformer
Decision rule
Channel identification
Power estimation
Constraints-set generator
Despreader # NI
19^NI
27^NI
29^NI
30^1
30^NI
18
Preprocessing
Constraint matrix generator
43A
34
44
Vector reshaper
47A^d
20A^d
29A^d
ISR beamformer
Decision rule
Despreader # d
Channel identification
Power estimation
19^d
28A^d
30A^d
to receivers for other desired users
to receivers for other desired users

FIG. 9

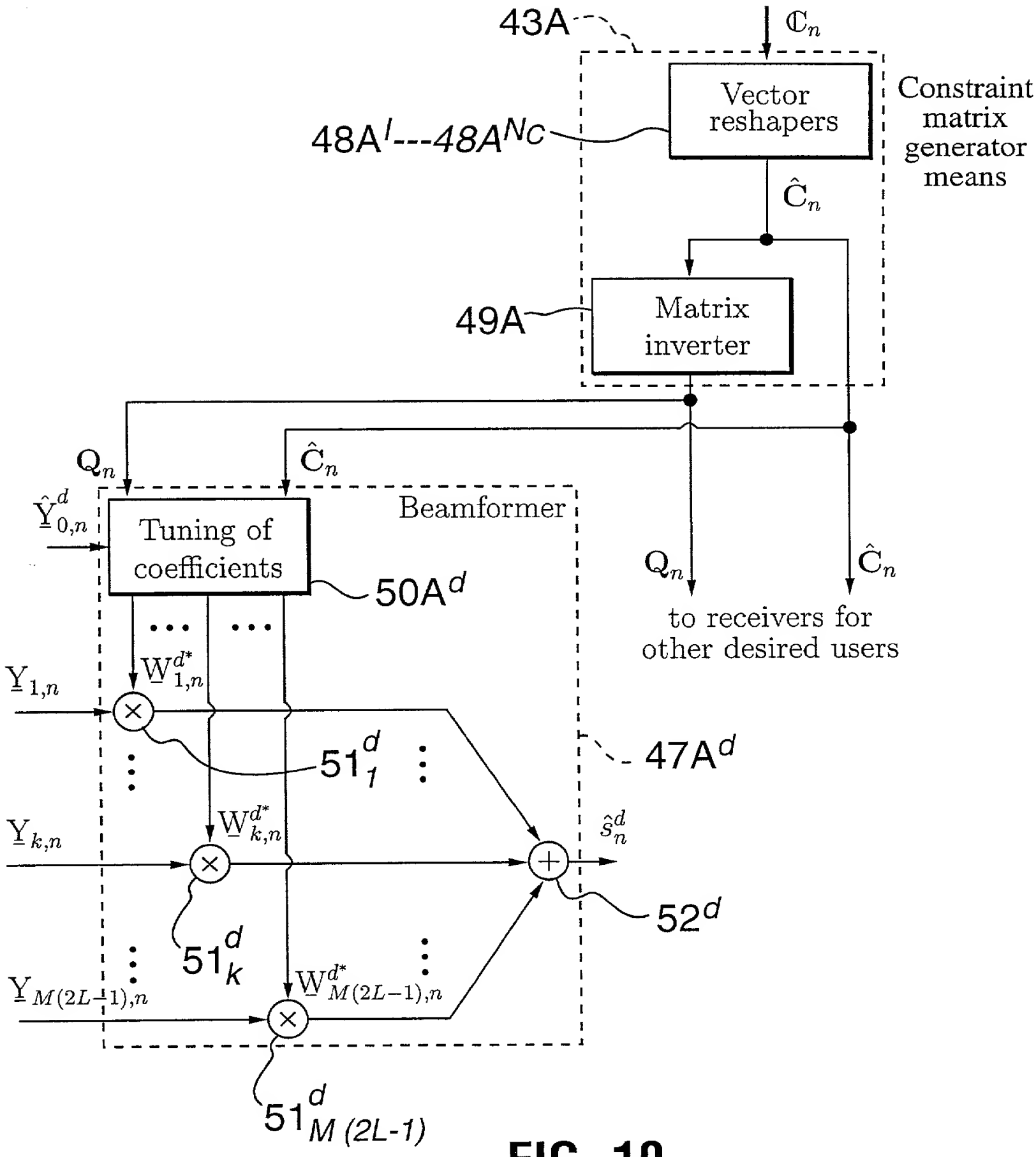

43A
$\mathbb{C}_n$
Vector reshapers
48A^1---48A^Nc
Constraint matrix generator means
$\hat{\mathbb{C}}_n$
49A
Matrix inverter
$\mathbb{Q}_n$
$\hat{\mathbb{C}}_n$
$\hat{\underline{Y}}^d_{0,n}$
Beamformer
Tuning of coefficients
50A^d
$\mathbb{Q}_n$
$\hat{\mathbb{C}}_n$
to receivers for other desired users
$\underline{Y}_{1,n}$
$\underline{W}^{d*}_{1,n}$
51^d_1
47A^d
$\underline{Y}_{k,n}$
$\underline{W}^{d*}_{k,n}$
$\hat{s}^d_n$
51^d_k
52^d
$\underline{Y}_{M(2L-1),n}$
$\underline{W}^{d*}_{M(2L-1),n}$
$51^d_{M(2L-1)}$

FIG. 10

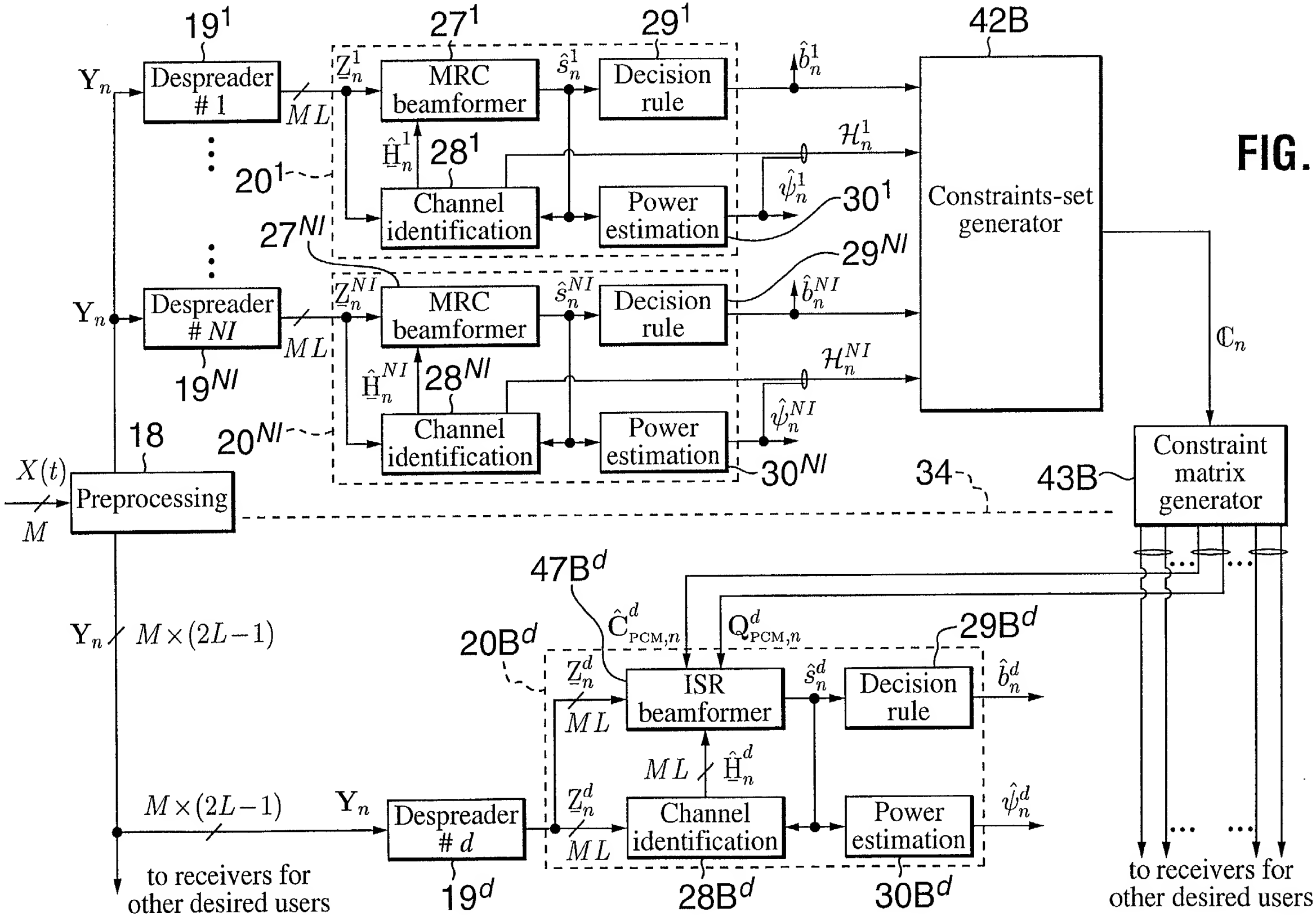

19^1
27^1
29^1
42B
Despreader # 1
MRC beamformer
Decision rule
Channel identification
Power estimation
Constraints-set generator
Despreader # NI
19^NI
20^1
20^NI
27^NI
28^1
28^NI
29^NI
30^1
30^NI
18
Preprocessing
X(t)
M
Constraint matrix generator
34
43B
47B^d
20B^d
29B^d
ISR beamformer
Despreader # d
19^d
28B^d
30B^d
to receivers for other desired users
to receivers for other desired users

FIG. 11

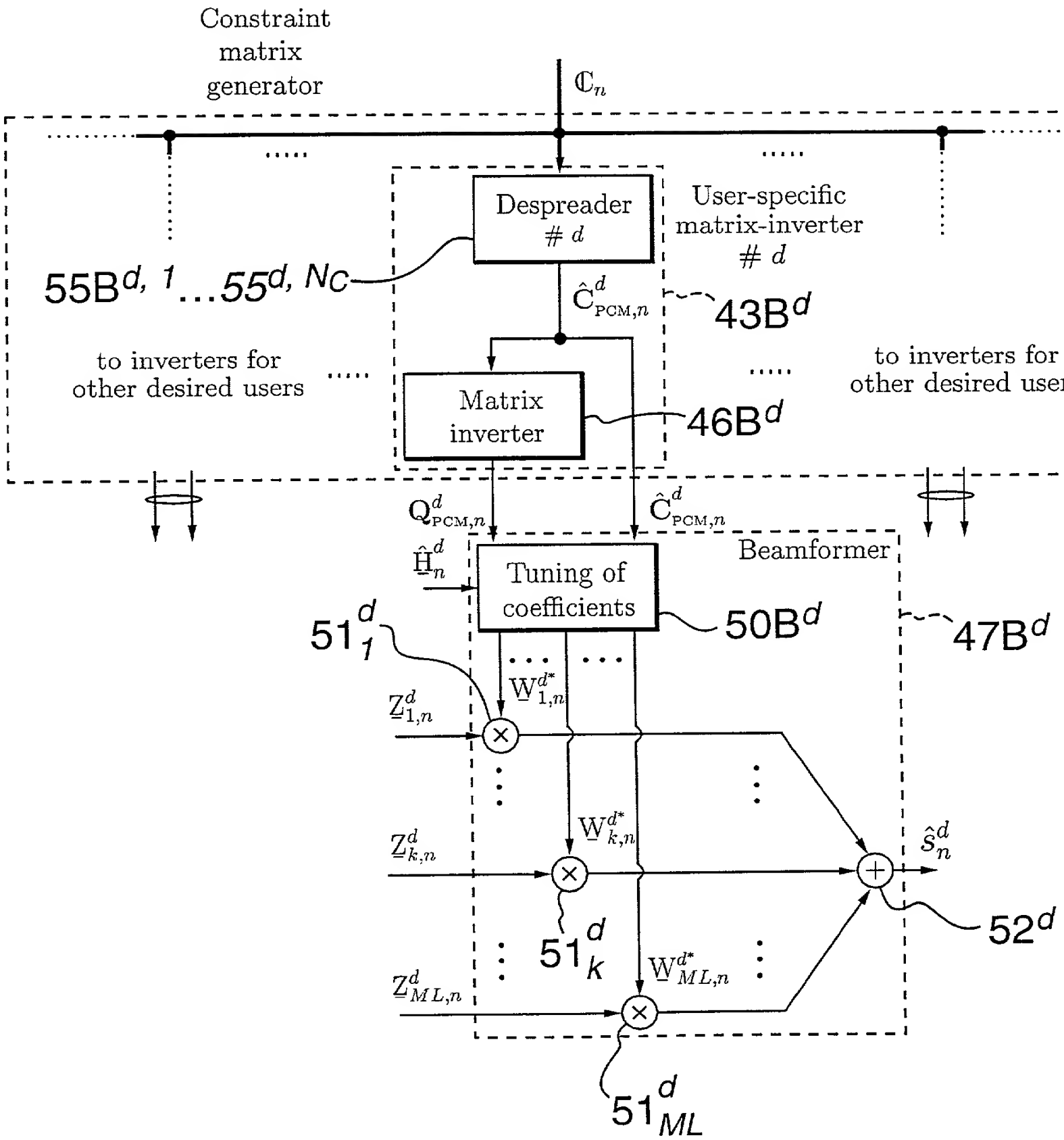

Constraint matrix generator
$\mathbb{C}_n$
Despreader # d
User-specific matrix-inverter # d
$55B^{d,1} \ldots 55^{d,Nc}$
$\hat{C}^d_{PCM,n}$
$43B^d$
to inverters for other desired users
Matrix inverter
$46B^d$
to inverters for other desired users
$Q^d_{PCM,n}$
$\hat{C}^d_{PCM,n}$
$\hat{H}^d_n$
Beamformer
Tuning of coefficients
$50B^d$
$47B^d$
51^d_1
$W^{d*}_{1,n}$
$Z^d_{1,n}$
$W^{d*}_{k,n}$
$Z^d_{k,n}$
$\hat{s}^d_n$
52^d
51^d_k
$W^{d*}_{ML,n}$
$Z^d_{ML,n}$
51^d_{ML}

FIG. 12

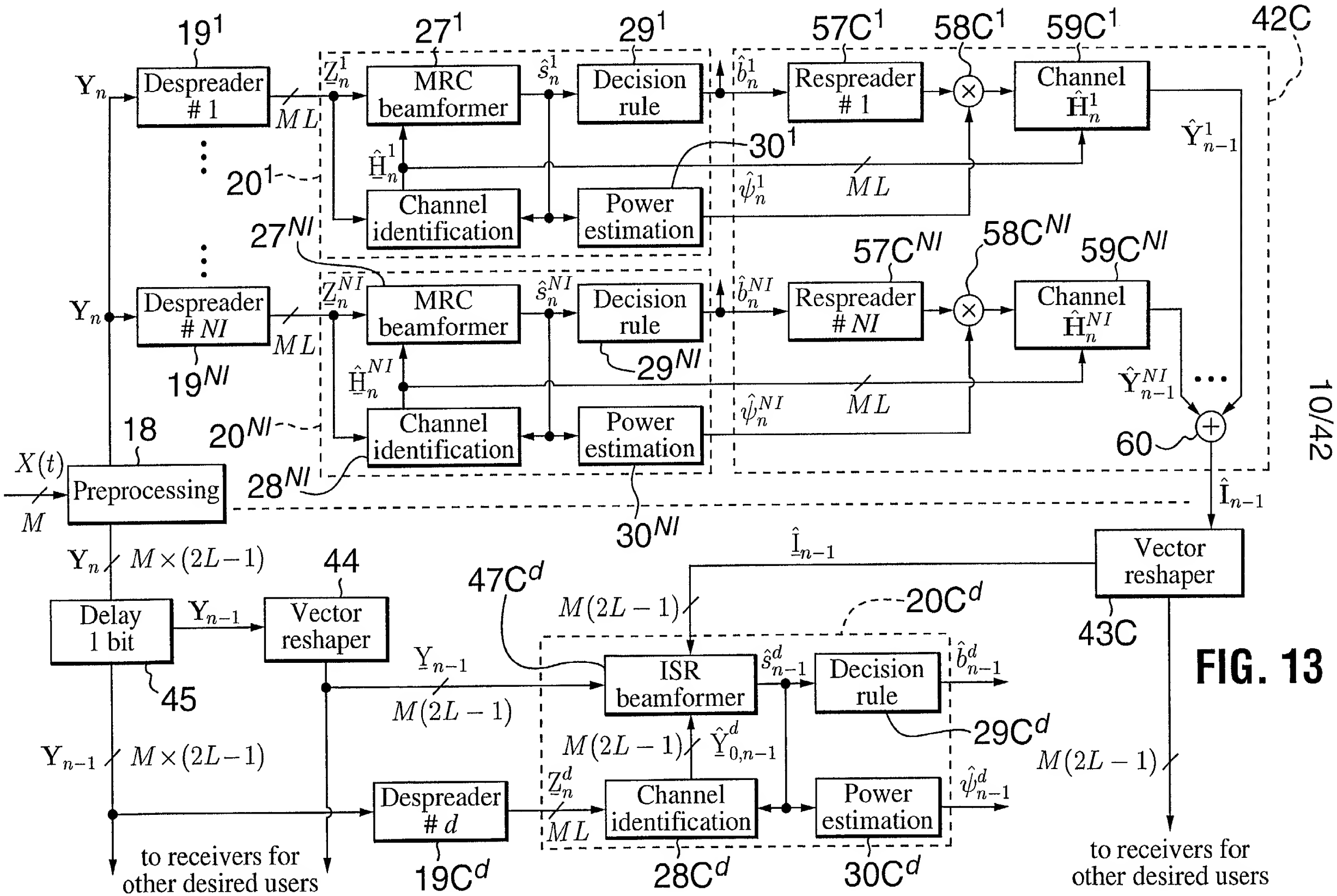

19^1
27^1
29^1
57C^1
58C^1
59C^1
42C
Y_n
Despreader # 1
ML
Z_n^1
MRC beamformer
ŝ_n^1
Decision rule
b̂_n^1
Respreader # 1
Channel Ĥ_n^1
Ŷ_{n-1}^1
Ĥ_n^1
20^1
30^1
Channel identification
Power estimation
ψ̂_n^1
ML
27^NI
57C^NI
58C^NI
59C^NI
Despreader # NI
19^NI
Z_n^NI
MRC beamformer
ŝ_n^NI
Decision rule
29^NI
b̂_n^NI
Respreader # NI
Channel Ĥ_n^NI
Ŷ_{n-1}^NI
Ĥ_n^NI
20^NI
Channel identification
Power estimation
ψ̂_n^NI
ML
60
18
X(t)
M
Preprocessing
28^NI
30^NI
Î_{n-1}
Y_n
M×(2L−1)
44
Vector reshaper
Delay 1 bit
Y_{n-1}
45
47C^d
M(2L−1)
20C^d
ISR beamformer
ŝ_{n-1}^d
Decision rule
b̂_{n-1}^d
29C^d
Ŷ_{0,n-1}^d
Despreader # d
Z_n^d
ML
Channel identification
Power estimation
ψ̂_{n-1}^d
19C^d
28C^d
30C^d
43C
Vector reshaper
to receivers for other desired users
to receivers for other desired users

FIG. 13

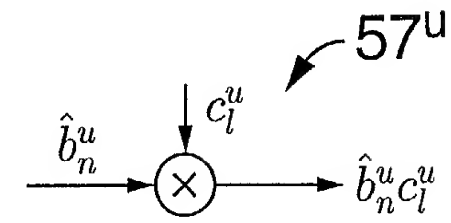

57u
$\hat{b}_n^u$
c_l^u
$\hat{b}_n^u c_l^u$

FIG. 14

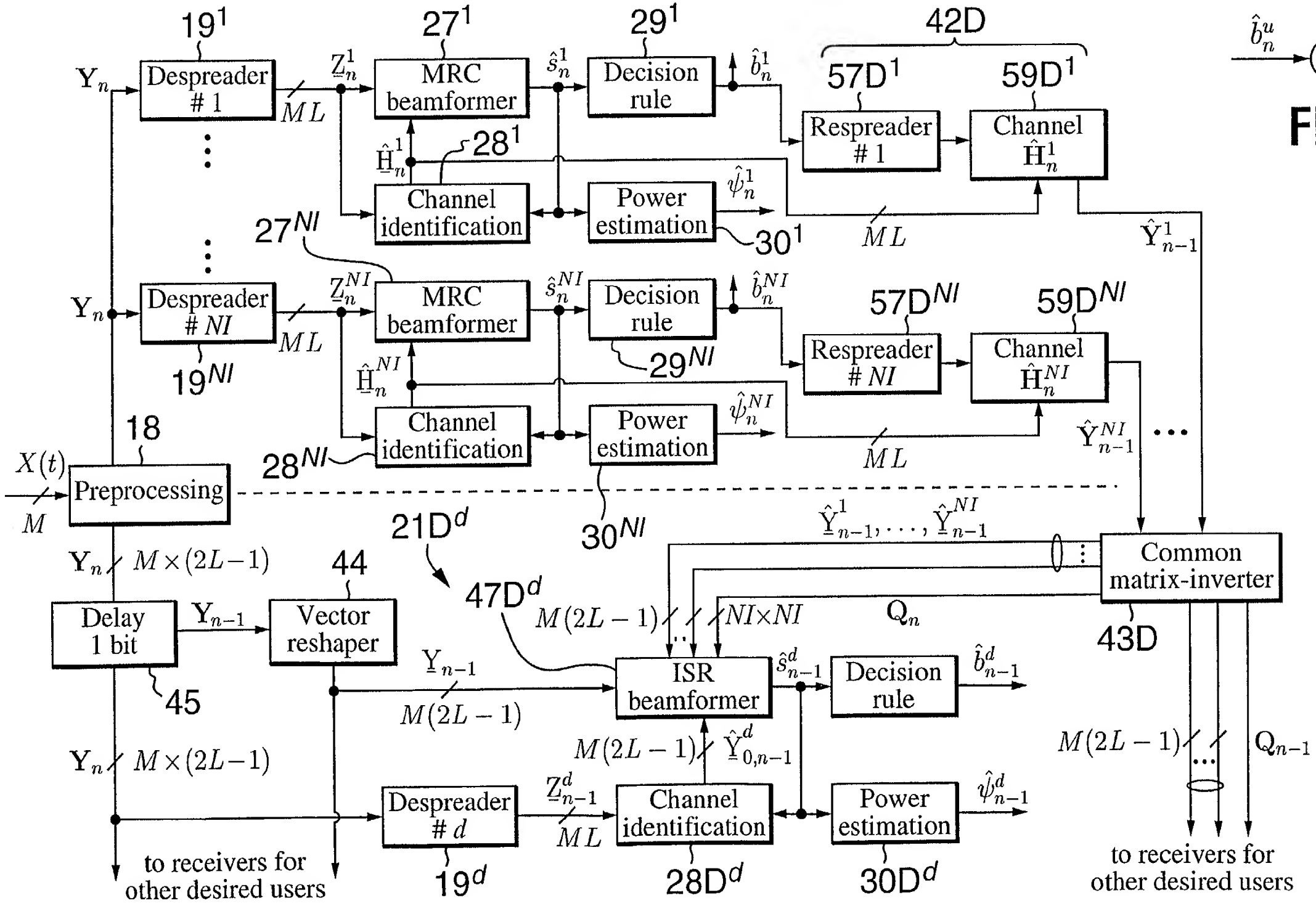

19¹
27¹
29¹
42D
57D¹
59D¹
Despreader # 1
MRC beamformer
Decision rule
Respreader # 1
Channel $\hat{H}_n^1$
Channel identification
Power estimation
28¹
30¹
27NI
Despreader # NI
MRC beamformer
Decision rule
Respreader # NI
Channel $\hat{H}_n^{NI}$
Channel identification
Power estimation
19NI
29NI
28NI
30NI
57DNI
59DNI
18
Preprocessing
21Dd
47Dd
44
Delay 1 bit
45
Vector reshaper
ISR beamformer
Decision rule
Common matrix-inverter
43D
Despreader # d
Channel identification
Power estimation
19d
28Dd
30Dd
to receivers for other desired users
to receivers for other desired users

FIG. 15

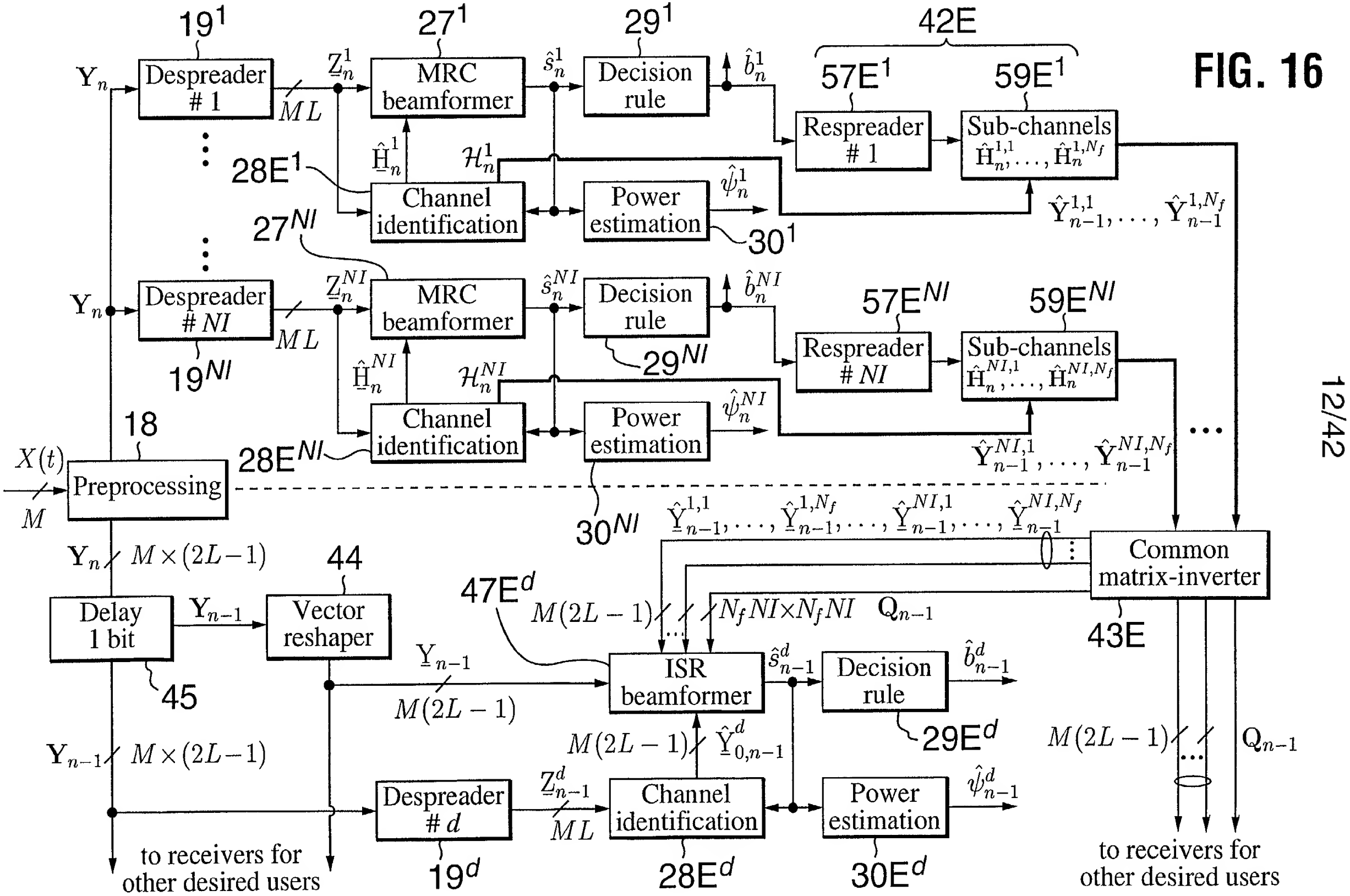

19^1
27^1
29^1
42E
57E^1
59E^1
Despreader # 1
MRC beamformer
Decision rule
Respreader # 1
Sub-channels
Channel identification
Power estimation
28E^1
27^NI
Despreader # NI
19^NI
MRC beamformer
Decision rule
29^NI
57E^NI
59E^NI
Respreader # NI
Sub-channels
Channel identification
Power estimation
28E^NI
30^NI
18
Preprocessing
X(t)
M
44
Vector reshaper
Delay 1 bit
45
47E^d
ISR beamformer
Decision rule
29E^d
Despreader # d
19^d
Channel identification
28E^d
Power estimation
30E^d
Common matrix-inverter
43E
to receivers for other desired users
to receivers for other desired users

FIG. 16

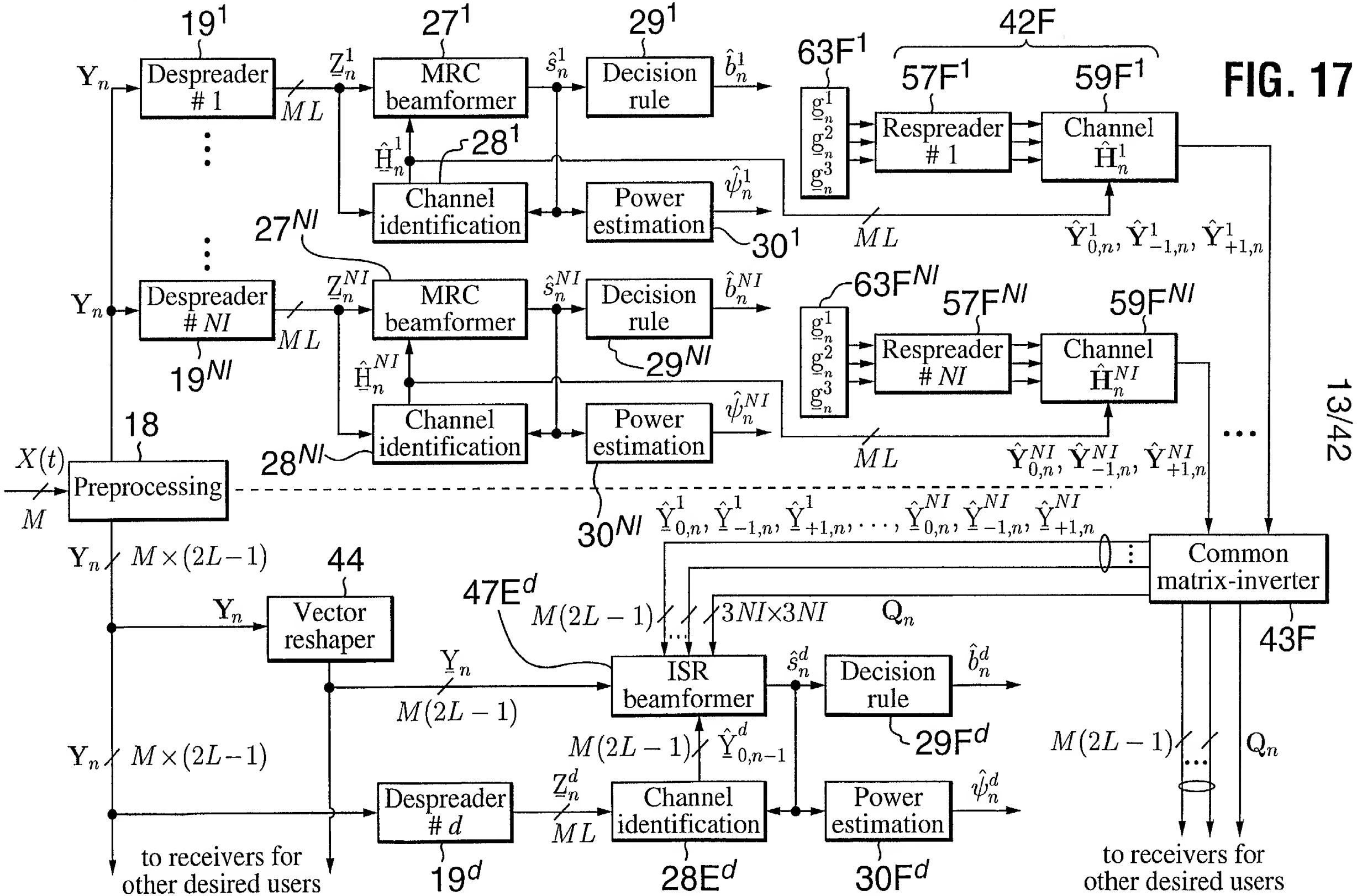

19^1
27^1
29^1
42F
63F^1
57F^1
59F^1
Y_n
Despreader # 1
Z_n^1
MRC beamformer
ŝ_n^1
Decision rule
b̂_n^1
ML
Ĥ_n^1
28^1
Channel identification
Power estimation
ψ̂_n^1
30^1
g_n^1 g_n^2 g_n^3
Respreader # 1
Channel Ĥ_n^1
Ŷ_{0,n}^1, Ŷ_{-1,n}^1, Ŷ_{+1,n}^1
27^NI
Despreader # NI
19^NI
Z_n^NI
MRC beamformer
ŝ_n^NI
Decision rule
b̂_n^NI
29^NI
63F^NI
57F^NI
59F^NI
Ĥ_n^NI
Channel identification
Power estimation
ψ̂_n^NI
28^NI
30^NI
Respreader # NI
Channel Ĥ_n^NI
Ŷ_{0,n}^NI, Ŷ_{-1,n}^NI, Ŷ_{+1,n}^NI
18
X(t)
M
Preprocessing
Y_n
M×(2L−1)
44
Vector reshaper
47E^d
M(2L−1)
3NI×3NI
Q_n
ISR beamformer
ŝ_n^d
Decision rule
b̂_n^d
29F^d
Ŷ_{0,n-1}^d
Despreader # d
Z_n^d
Channel identification
Power estimation
ψ̂_n^d
19^d
28E^d
30F^d
Common matrix-inverter
43F
to receivers for other desired users
to receivers for other desired users

FIG. 17

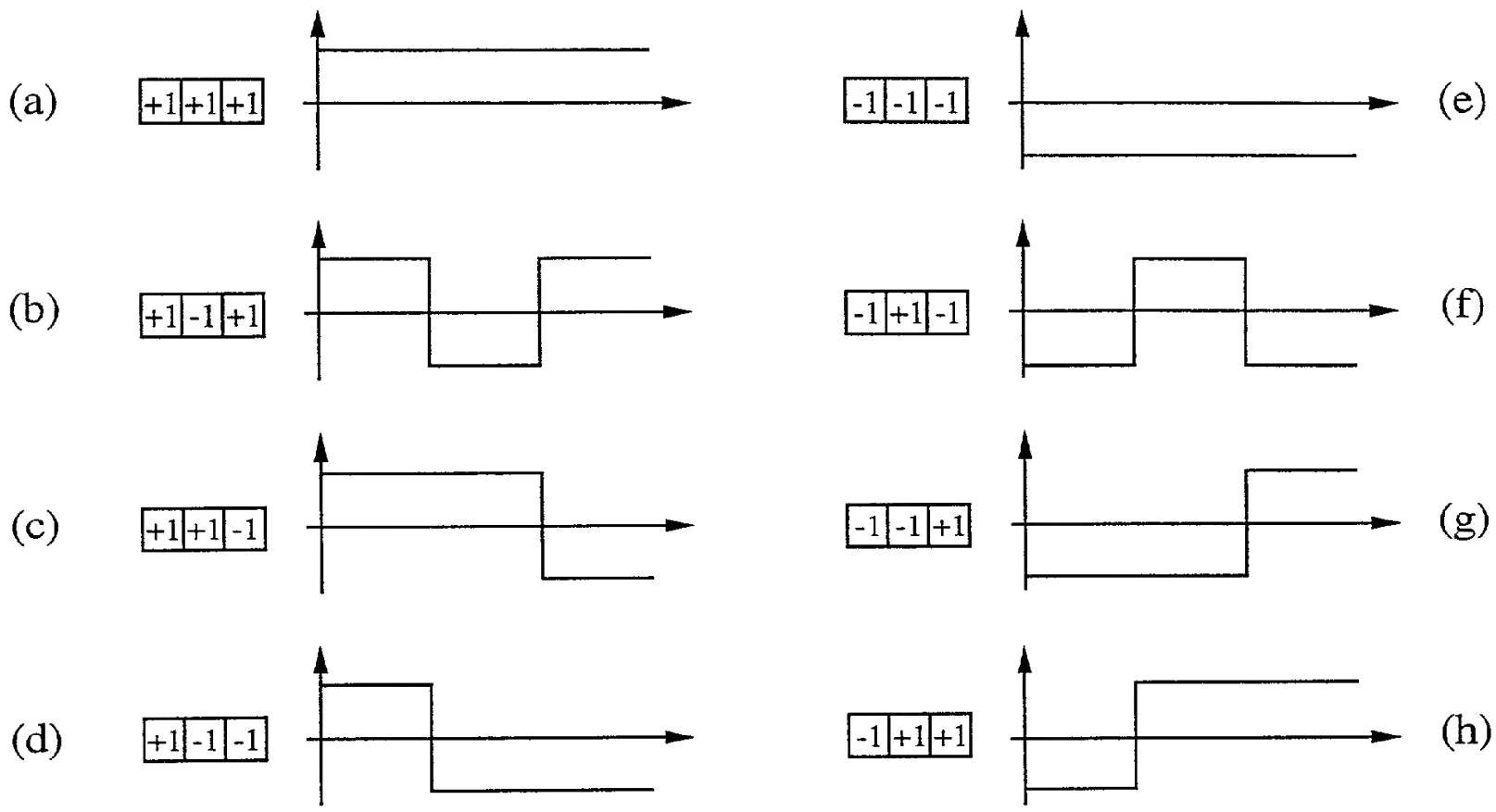

(a)
+1 +1 +1
(b)
+1 -1 +1
(c)
+1 +1 -1
(d)
+1 -1 -1
(e)
-1 -1 -1
(f)
-1 +1 -1
(g)
-1 -1 +1
(h)
-1 +1 +1

FIG. 18

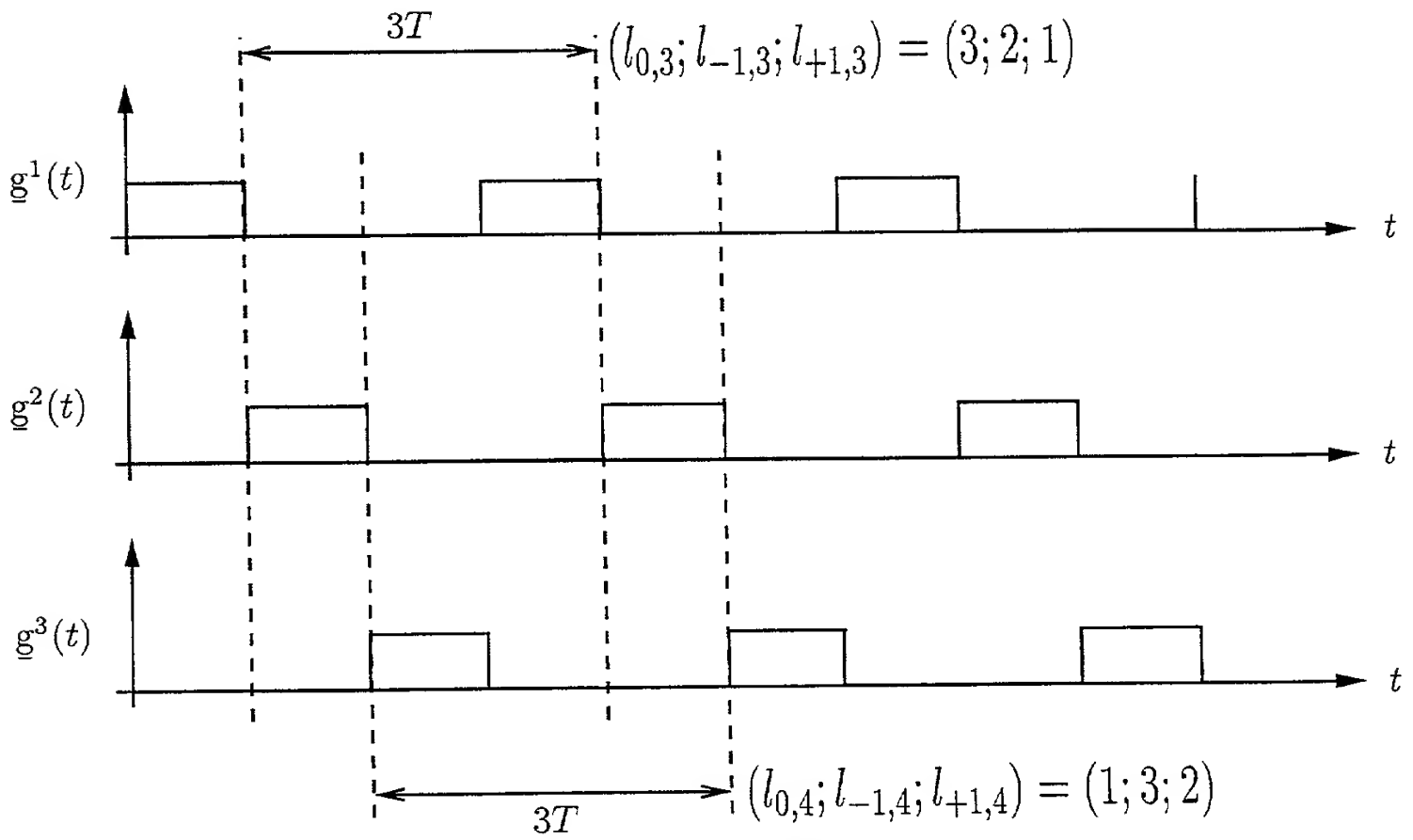
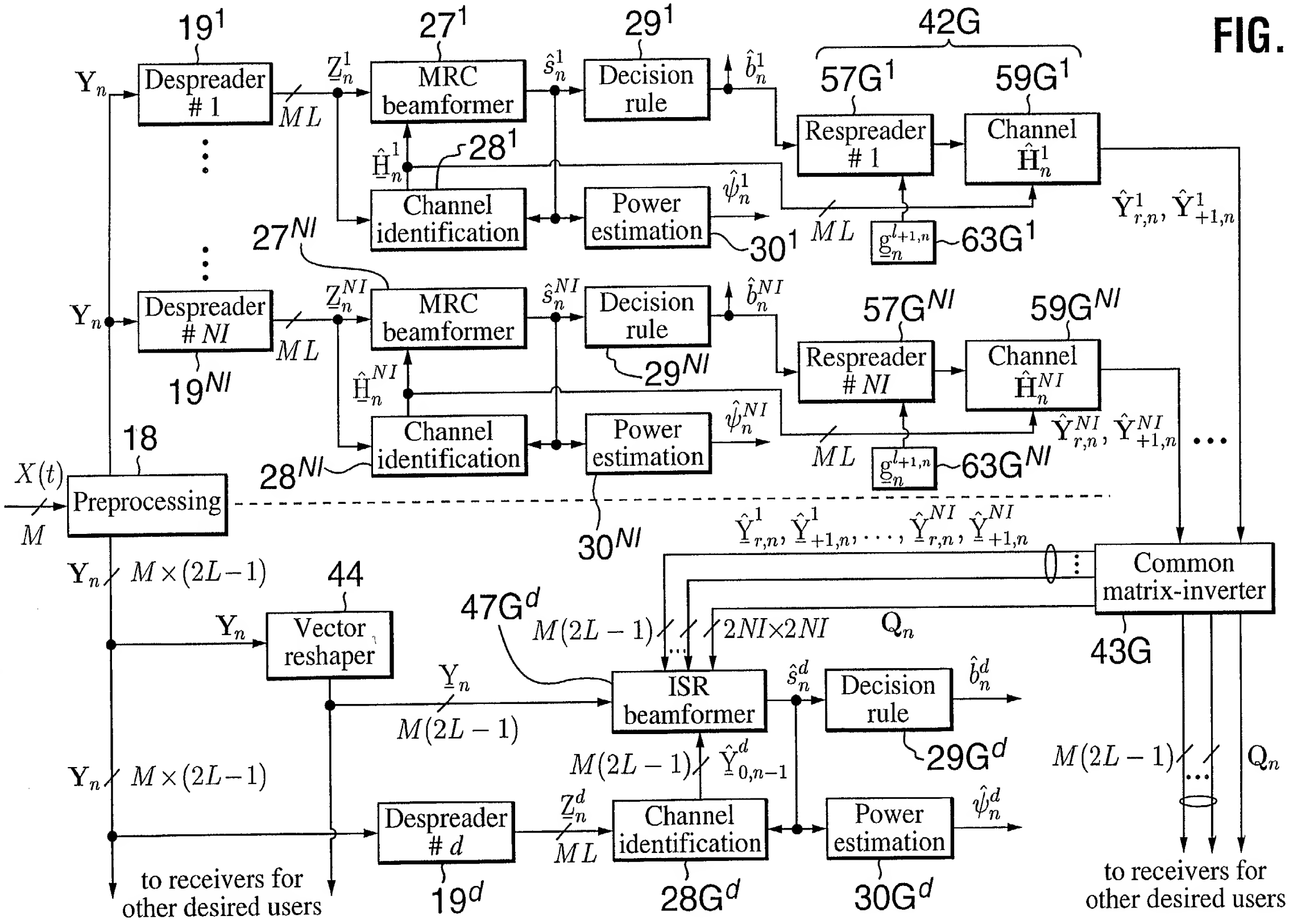

3T
$(l_{0,3}; l_{-1,3}; l_{+1,3}) = (3; 2; 1)$
$g^1(t)$
$g^2(t)$
$g^3(t)$
t
t
t
3T
$(l_{0,4}; l_{-1,4}; l_{+1,4}) = (1; 3; 2)$

FIG. 19

FIG. 20


19^1
27^1
29^1
42G
Despreader # 1
MRC beamformer
Decision rule
57G^1
59G^1
Respreader # 1
Channel Ĥ_n^1
28^1
Channel identification
Power estimation
30^1
63G^1
27^NI
Despreader # NI
19^NI
MRC beamformer
Decision rule
29^NI
57G^NI
59G^NI
Respreader # NI
Channel Ĥ_n^NI
28^NI
Channel identification
Power estimation
30^NI
63G^NI
18
Preprocessing
X(t)
M
Y_n
M×(2L−1)
44
Vector reshaper
47G^d
M(2L−1)
2NI×2NI
Q_n
Common matrix-inverter
43G
ISR beamformer
Decision rule
29G^d
Despreader # d
19^d
Channel identification
28G^d
Power estimation
30G^d
to receivers for other desired users
to receivers for other desired users

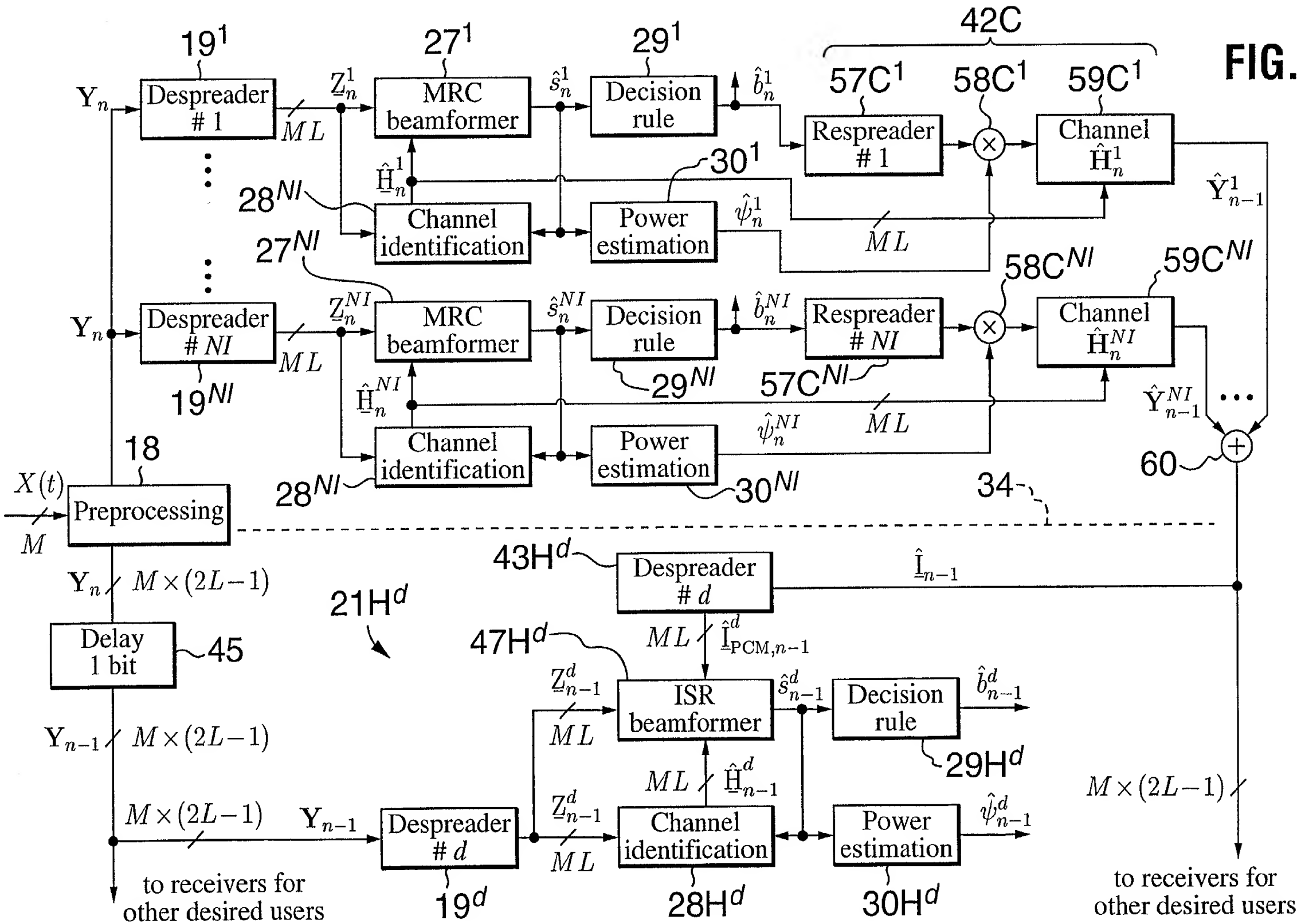
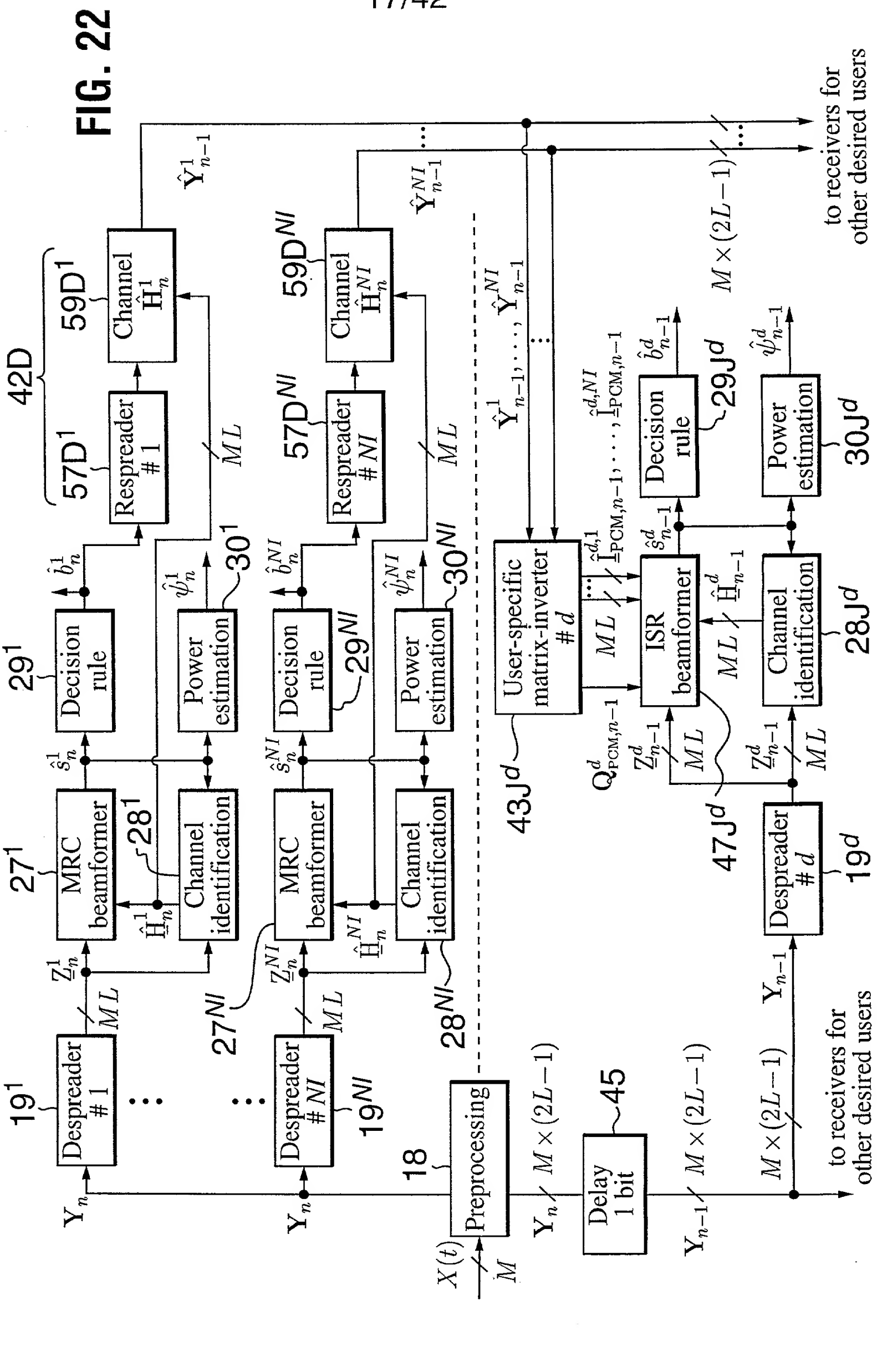

19^1
27^1
29^1
42C
57C^1
58C^1
59C^1
Despreader # 1
MRC beamformer
Decision rule
Respreader # 1
Channel Ĥ_n^1
Channel identification
Power estimation
30^1
28^NI
27^NI
Despreader # NI
MRC beamformer
Decision rule
Respreader # NI
Channel Ĥ_n^NI
58C^NI
59C^NI
19^NI
29^NI
57C^NI
Channel identification
Power estimation
28^NI
30^NI
60
34
18
X(t)
Preprocessing
M
Delay 1 bit
45
21H^d
43H^d
Despreader # d
47H^d
ISR beamformer
Decision rule
29H^d
Despreader # d
19^d
Channel identification
28H^d
Power estimation
30H^d
to receivers for other desired users
to receivers for other desired users

FIG. 21

FIG. 22


42D
57D1
59D1
Respreader # 1
Channel $\hat{H}_n^1$
$\hat{Y}_{n-1}^1$
57D^NI
59D^NI
Respreader # NI
Channel $\hat{H}_n^{NI}$
$\hat{Y}_{n-1}^{NI}$
ML
$\hat{Y}_{n-1}^1, \ldots, \hat{Y}_{n-1}^{NI}$
$\hat{I}_{PCM,n-1}^{d,1}, \ldots, \hat{I}_{PCM,n-1}^{d,NI}$
Decision rule
29J^d
$\hat{b}_{n-1}^d$
$\hat{s}_{n-1}^d$
$M \times (2L-1)$
Power estimation
30J^d
$\hat{\psi}_{n-1}^d$
to receivers for other desired users
$\hat{b}_n^1$
29^1
Decision rule
$\hat{\psi}_n^1$
30^1
Power estimation
$\hat{s}_n^1$
$\hat{b}_n^{NI}$
29^NI
Decision rule
$\hat{\psi}_n^{NI}$
30^NI
Power estimation
$\hat{s}_n^{NI}$
27^1
MRC beamformer
28^1
Channel identification
$\hat{H}_n^1$
27^NI
MRC beamformer
28^NI
Channel identification
$\hat{H}_n^{NI}$
Z_n^1
Z_n^{NI}
ML
19^1
Despreader # 1
19^NI
Despreader # NI
Y_n
18
Preprocessing
$X(t)$
M
Y_n
$M \times (2L-1)$
45
Delay 1 bit
Y_{n-1}
$M \times (2L-1)$
to receivers for other desired users
43J^d
User-specific matrix-inverter # d
$Q_{PCM,n-1}^d$
$\hat{I}_{PCM,n-1}^{d,1}$
ML
47J^d
ISR beamformer
Z_{n-1}^d
ML
$\hat{H}_{n-1}^d$
ML
28J^d
Channel identification
Z_{n-1}^d
ML
19^d
Despreader # d
Y_{n-1}

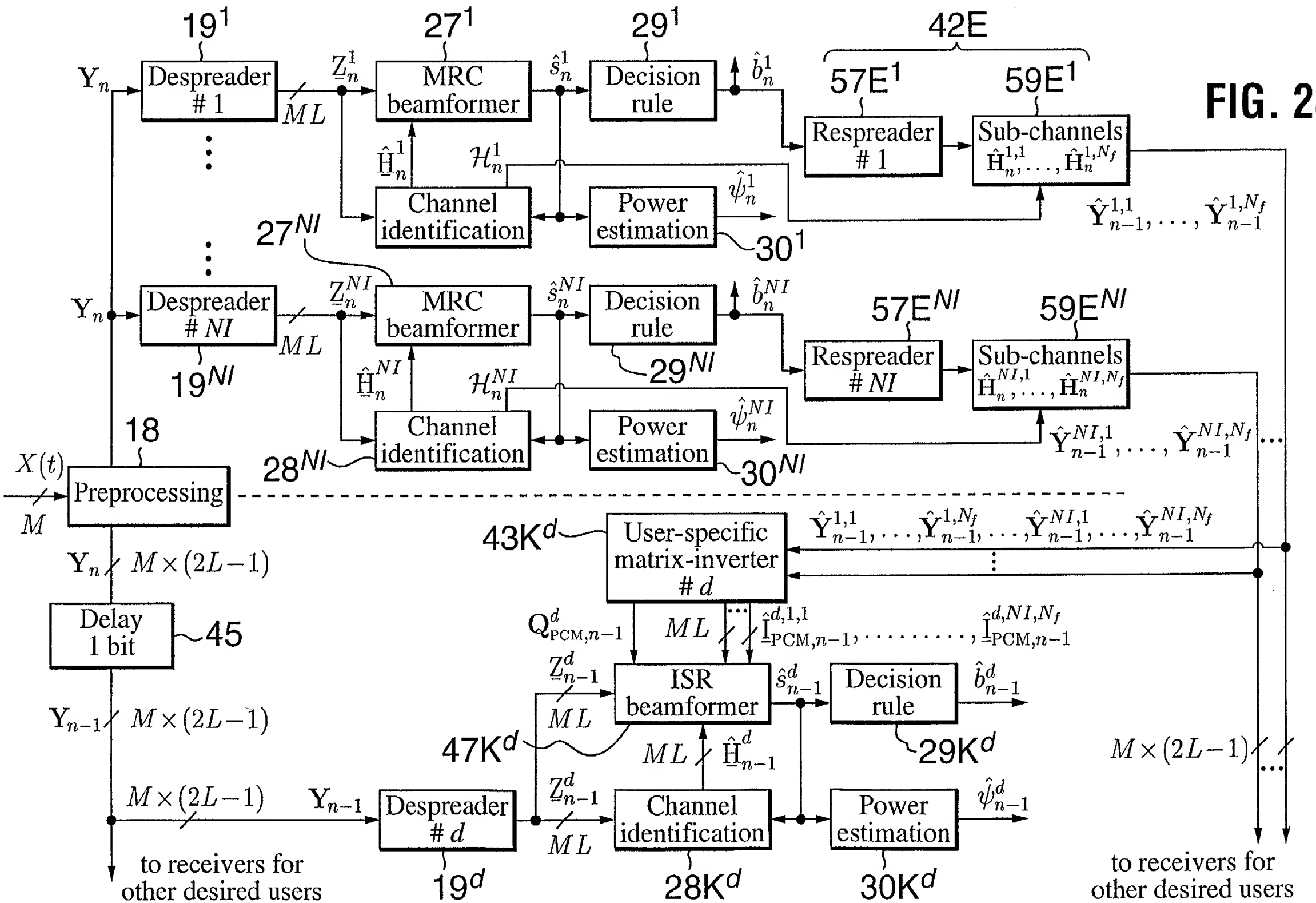

19^1
27^1
29^1
42E
57E^1
59E^1
Despreader # 1
MRC beamformer
Decision rule
Respreader # 1
Sub-channels
Channel identification
Power estimation
27^NI
Despreader # NI
19^NI
MRC beamformer
Decision rule
29^NI
57E^NI
59E^NI
Respreader # NI
Sub-channels
Channel identification
Power estimation
28^NI
30^NI
18
Preprocessing
X(t)
M
Delay 1 bit
45
43K^d
User-specific matrix-inverter # d
ISR beamformer
Decision rule
29K^d
47K^d
Despreader # d
19^d
Channel identification
28K^d
Power estimation
30K^d
to receivers for other desired users
to receivers for other desired users

FIG. 23

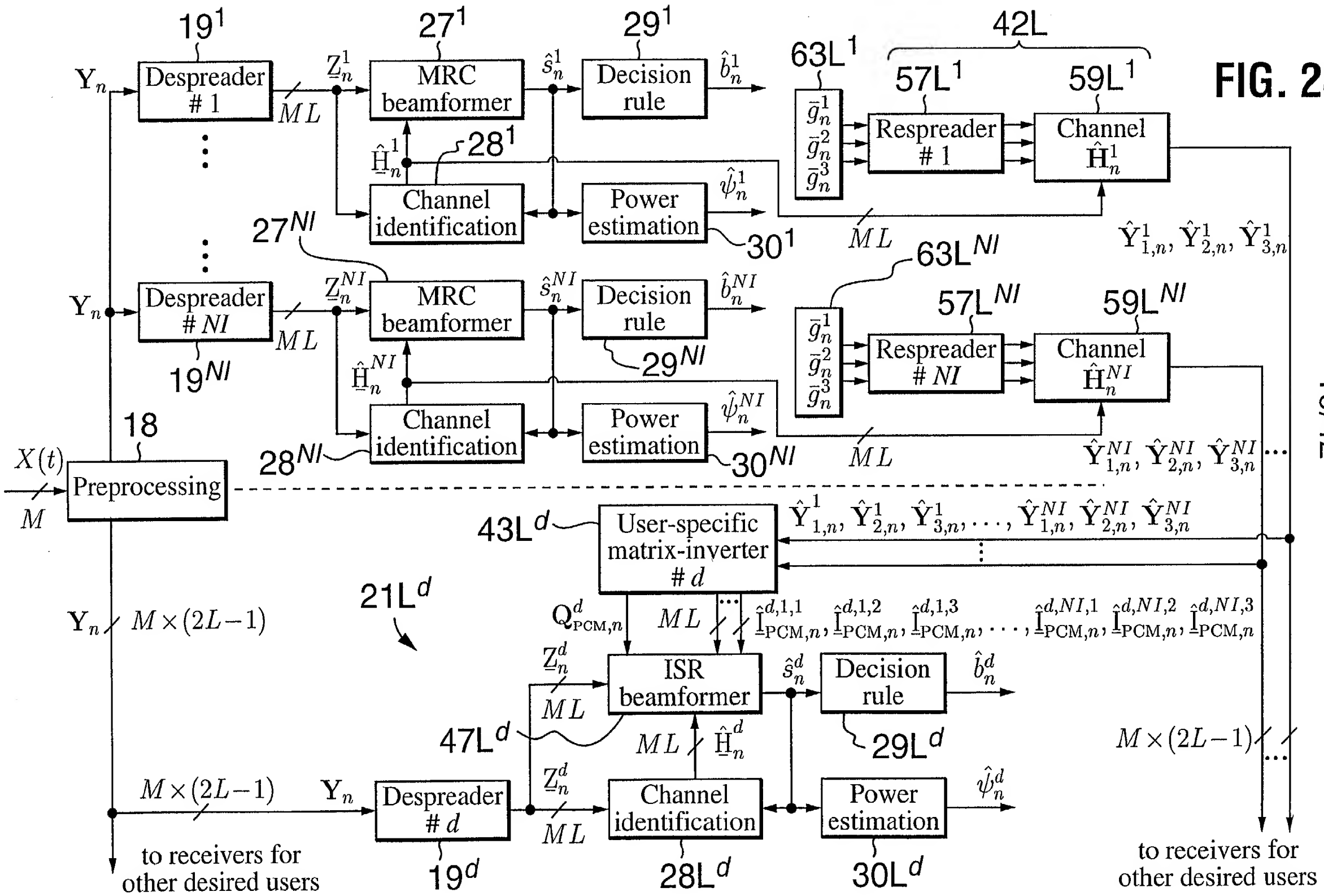

19^1
27^1
29^1
42L
63L^1
57L^1
59L^1
Despreader # 1
MRC beamformer
Decision rule
Respreader # 1
Channel Ĥ^1_n
Channel identification
Power estimation
28^1
30^1
27^NI
63L^NI
57L^NI
59L^NI
Despreader # NI
MRC beamformer
Decision rule
Respreader # NI
Channel Ĥ^NI_n
19^NI
29^NI
28^NI
30^NI
18
Preprocessing
X(t)
M
ML
Y_n
M×(2L−1)
43L^d
User-specific matrix-inverter # d
21L^d
ISR beamformer
47L^d
Decision rule
29L^d
Despreader # d
Channel identification
Power estimation
19^d
28L^d
30L^d
to receivers for other desired users
to receivers for other desired users

FIG. 24

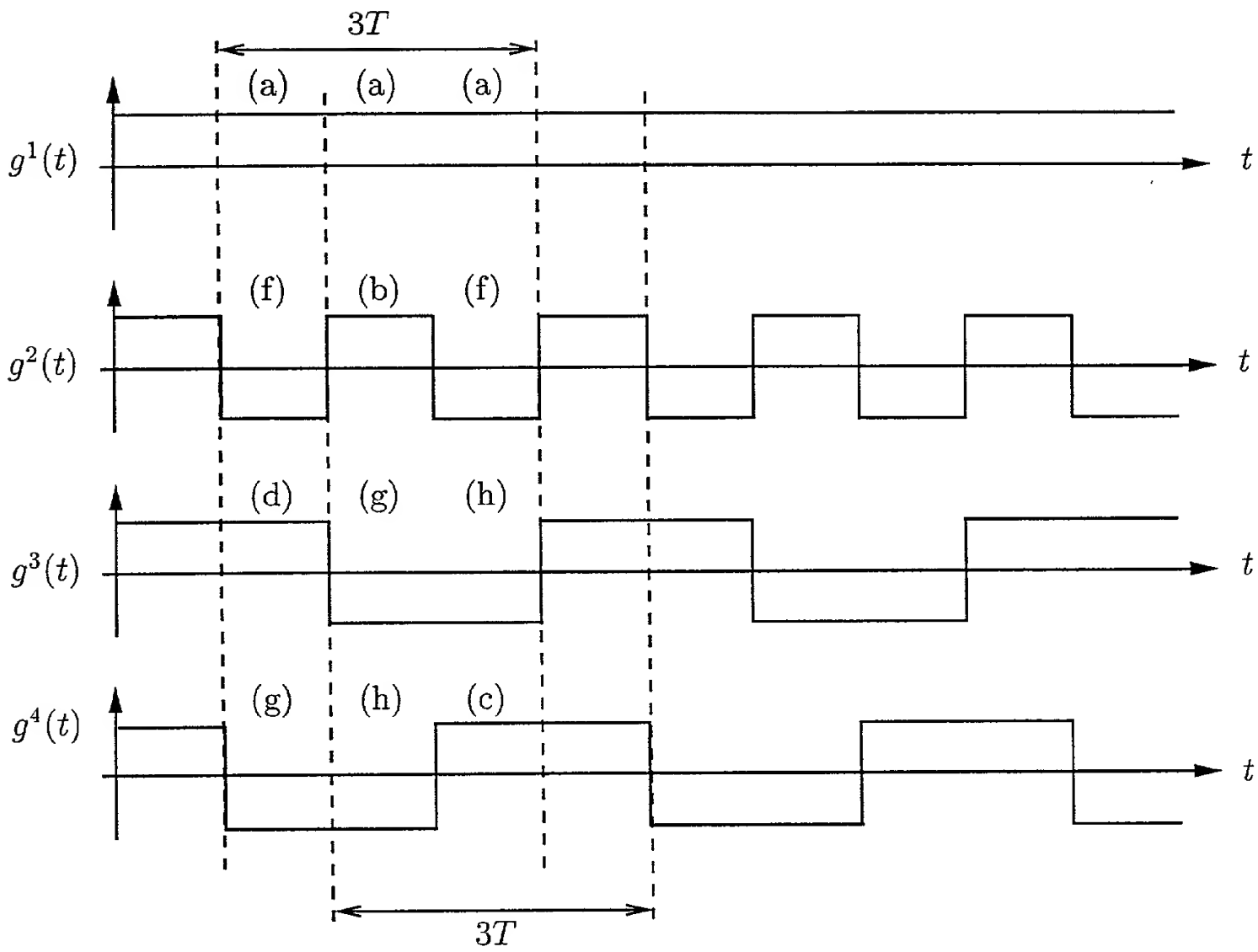


FIG. 25

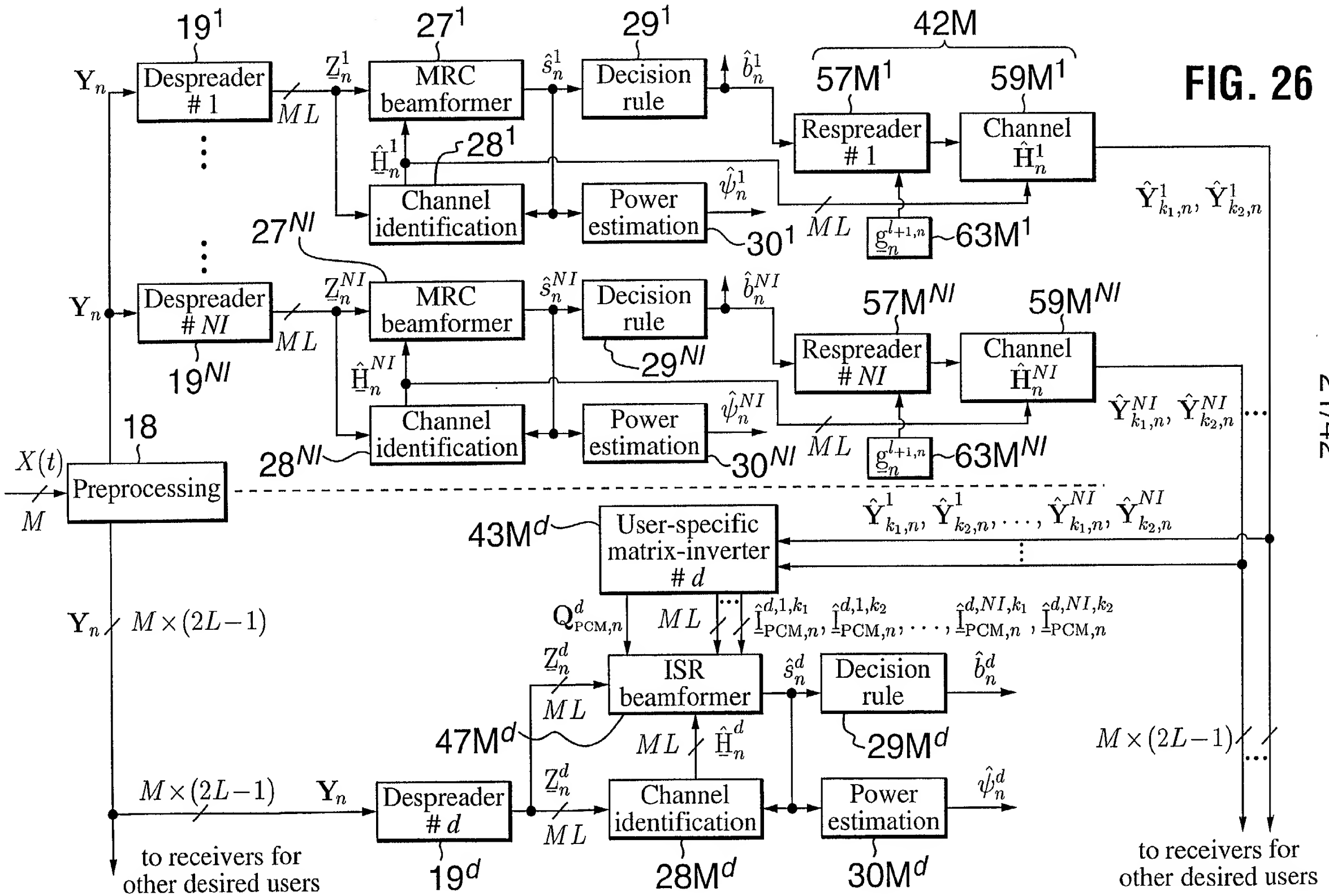

19^1
27^1
29^1
42M
Despreader # 1
MRC beamformer
Decision rule
57M^1
59M^1
Respreader # 1
Channel Ĥ_n^1
Channel identification
Power estimation
28^1
30^1
63M^1
27^NI
Despreader # NI
MRC beamformer
Decision rule
57M^NI
59M^NI
Respreader # NI
Channel Ĥ_n^NI
19^NI
29^NI
Channel identification
Power estimation
28^NI
30^NI
63M^NI
18
Preprocessing
X(t)
M
43M^d
User-specific matrix-inverter # d
ISR beamformer
Decision rule
47M^d
29M^d
Despreader # d
Channel identification
Power estimation
19^d
28M^d
30M^d
M × (2L−1)
to receivers for other desired users
to receivers for other desired users

FIG. 26

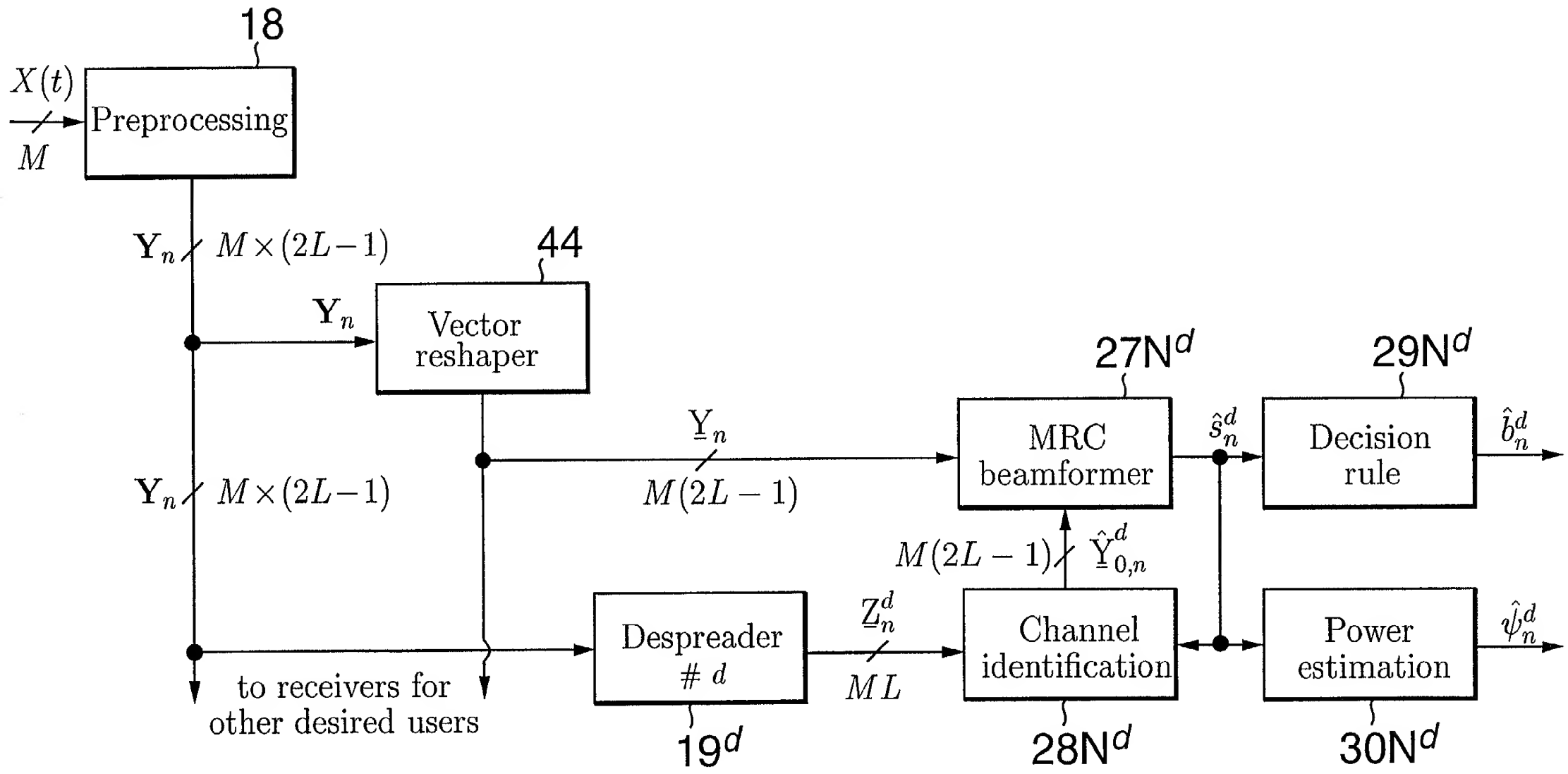
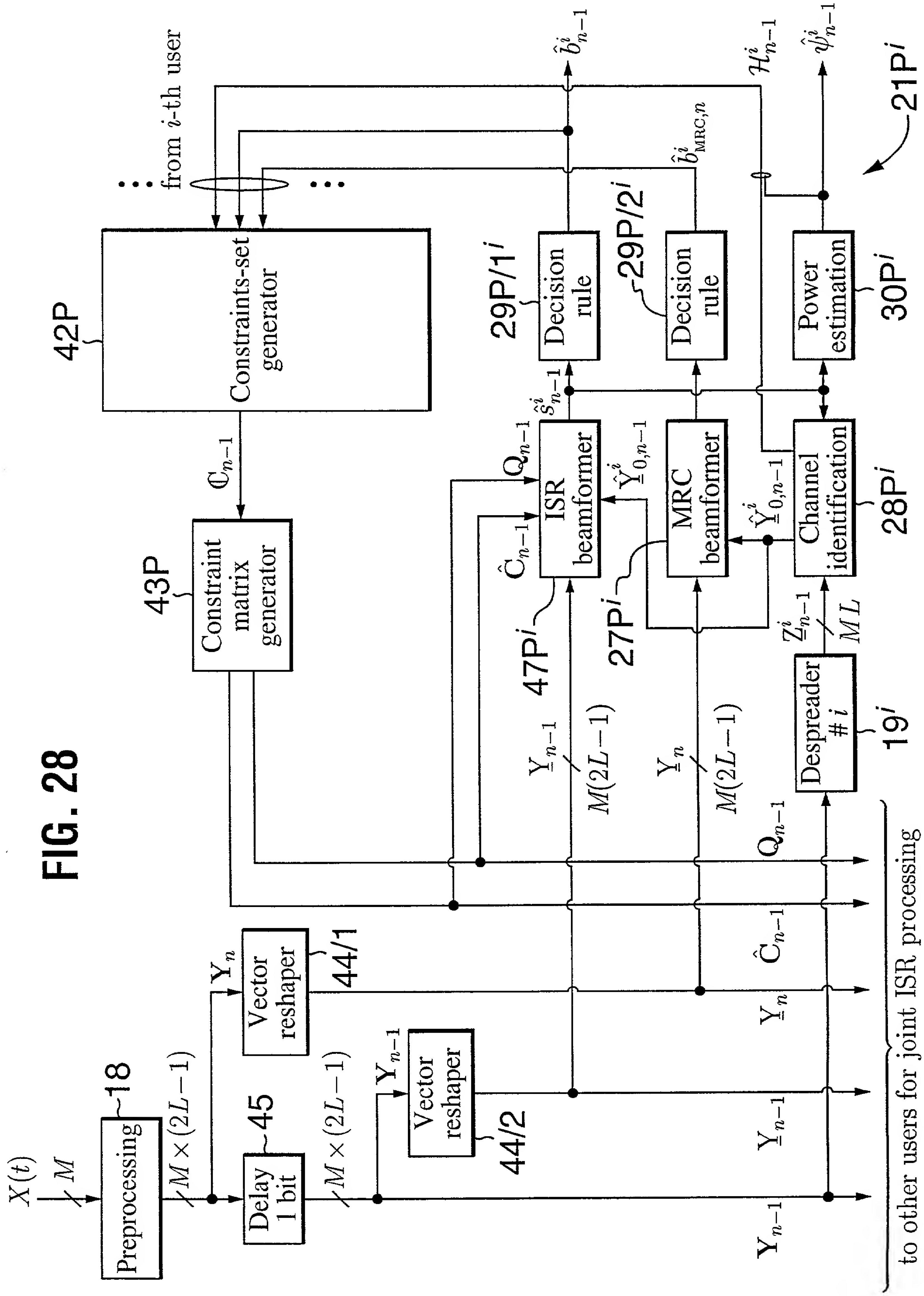

18
$X(t)$
M
Preprocessing
$\mathbf{Y}_n$ $M\times(2L-1)$
44
$\mathbf{Y}_n$
Vector reshaper
$\mathbf{Y}_n$ $M\times(2L-1)$
$\underline{Y}_n$
$M(2L-1)$
27N^d
MRC beamformer
$\hat{s}_n^d$
29N^d
Decision rule
$\hat{b}_n^d$
$M(2L-1)$ $\hat{\underline{Y}}_{0,n}^d$
to receivers for other desired users
Despreader # d
19^d
$\underline{Z}_n^d$
ML
Channel identification
28N^d
Power estimation
30N^d
$\hat{\psi}_n^d$

FIG. 27

FIG. 28


X(t)
M
Preprocessing
18
M×(2L−1)
Delay 1 bit
45
Vector reshaper
44/1
Vector reshaper
44/2
Constraints-set generator
42P
Constraint matrix generator
43P
ISR beamformer
47P^i
MRC beamformer
27P^i
Channel identification
28P^i
Despreader # i
19^i
Decision rule
29P/1^i
Decision rule
29P/2^i
Power estimation
30P^i
21P^i
from i-th user
M(2L−1)
ML
to other users for joint ISR processing

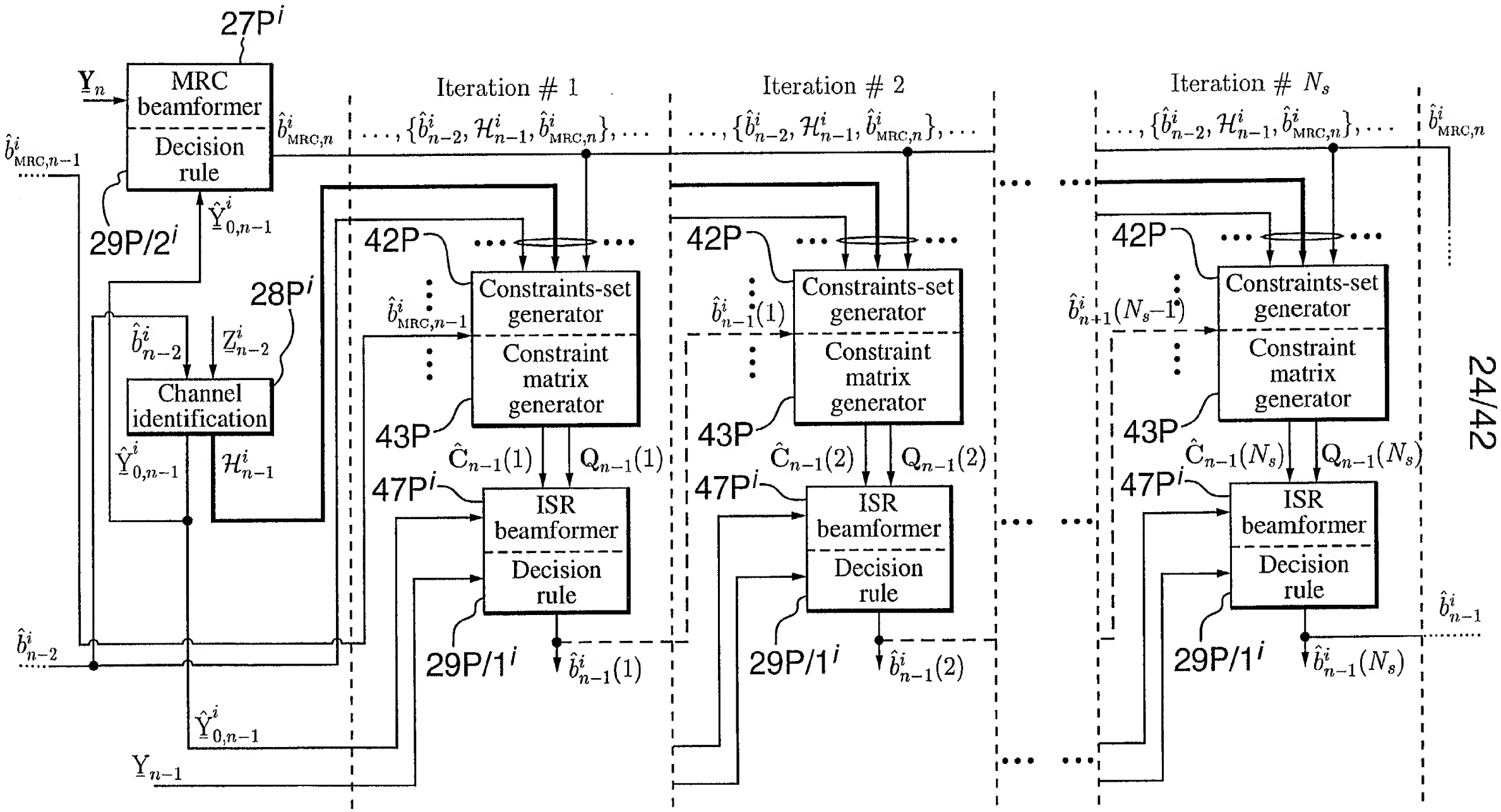

27P^i
MRC beamformer
Decision rule
29P/2^i
28P^i
Channel identification
Iteration # 1
Iteration # 2
Iteration # N_s
42P
Constraints-set generator
Constraint matrix generator
43P
47P^i
ISR beamformer
Decision rule
29P/1^i
Y_n
Y_{n-1}
b̂^i_{MRC,n}
b̂^i_{MRC,n-1}
b̂^i_{n-2}
Ẑ^i_{n-2}
Ŷ^i_{0,n-1}
H^i_{n-1}
Ĉ_{n-1}(1)
Q_{n-1}(1)
Ĉ_{n-1}(2)
Q_{n-1}(2)
Ĉ_{n-1}(N_s)
Q_{n-1}(N_s)
b̂^i_{n-1}(1)
b̂^i_{n-1}(2)
b̂^i_{n-1}(N_s)
b̂^i_{n+1}(N_s-1)
b̂^i_{n-1}

FIG. 29

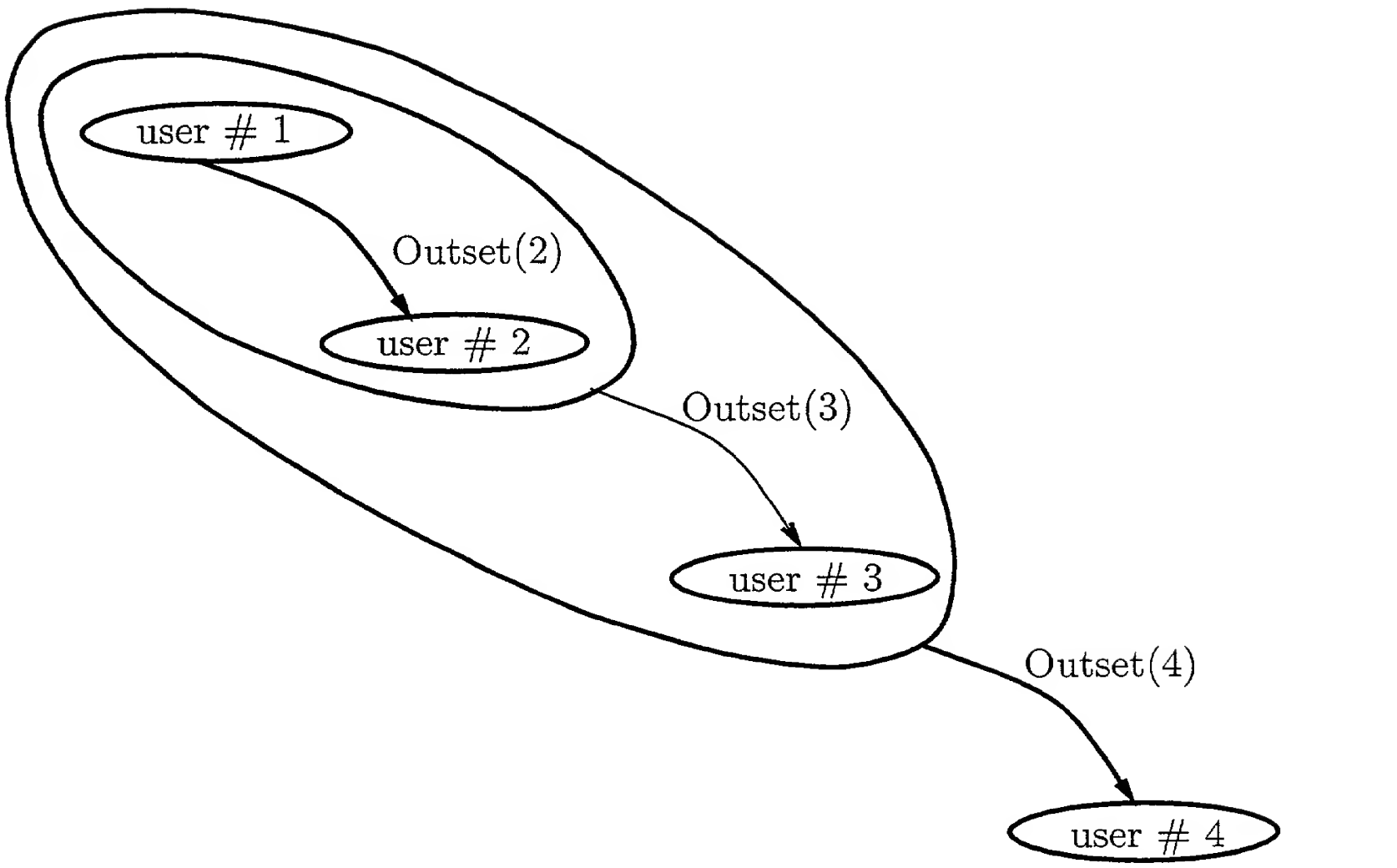


FIG. 30

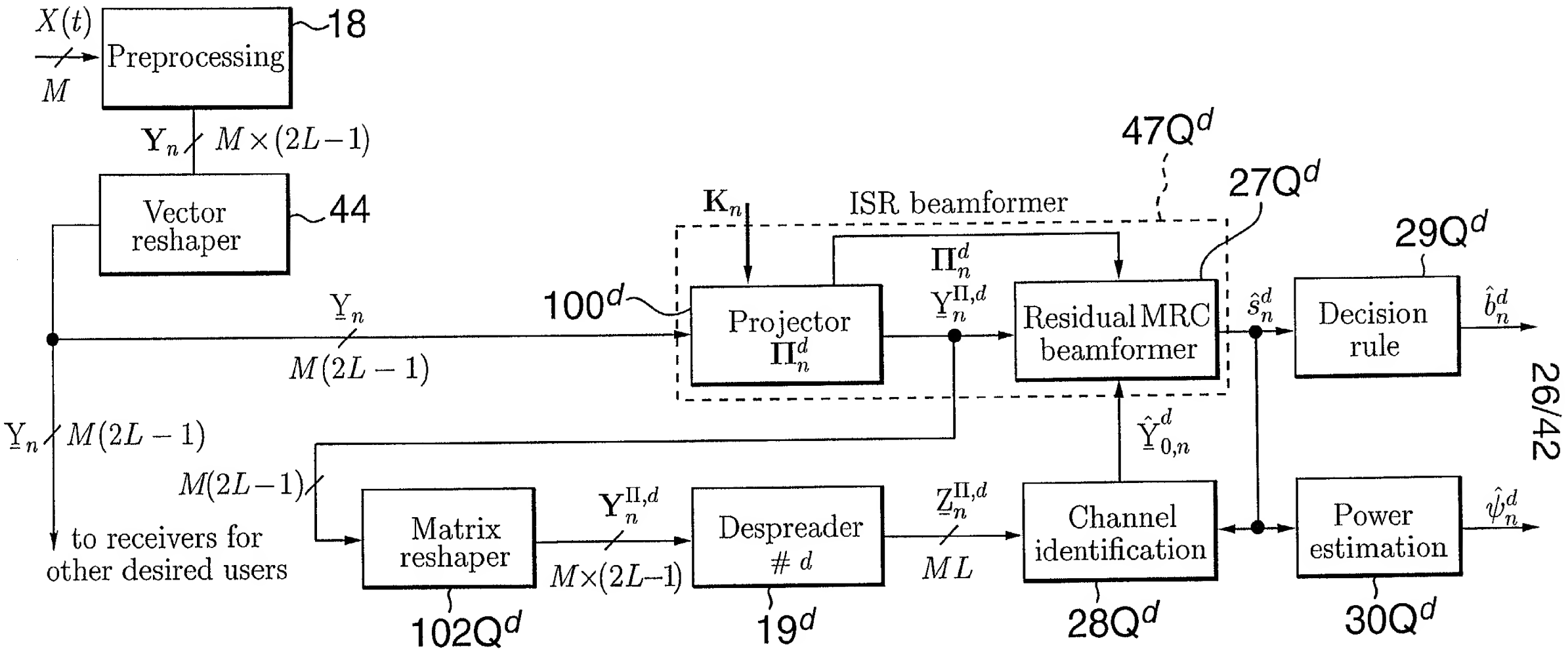

X(t)
M
Preprocessing
18
Y_n
M×(2L−1)
Vector reshaper
44
47Q^d
27Q^d
K_n
ISR beamformer
Π_n^d
29Q^d
Y_n
M(2L−1)
100^d
Projector Π_n^d
Y_n^{Π,d}
Residual MRC beamformer
ŝ_n^d
Decision rule
b̂_n^d
Y_n
M(2L−1)
Ŷ_{0,n}^d
26/42
M(2L−1)
to receivers for other desired users
Matrix reshaper
Y_n^{Π,d}
M×(2L−1)
Despreader # d
Z_n^{Π,d}
ML
Channel identification
Power estimation
ψ̂_n^d
102Q^d
19^d
28Q^d
30Q^d

FIG. 31

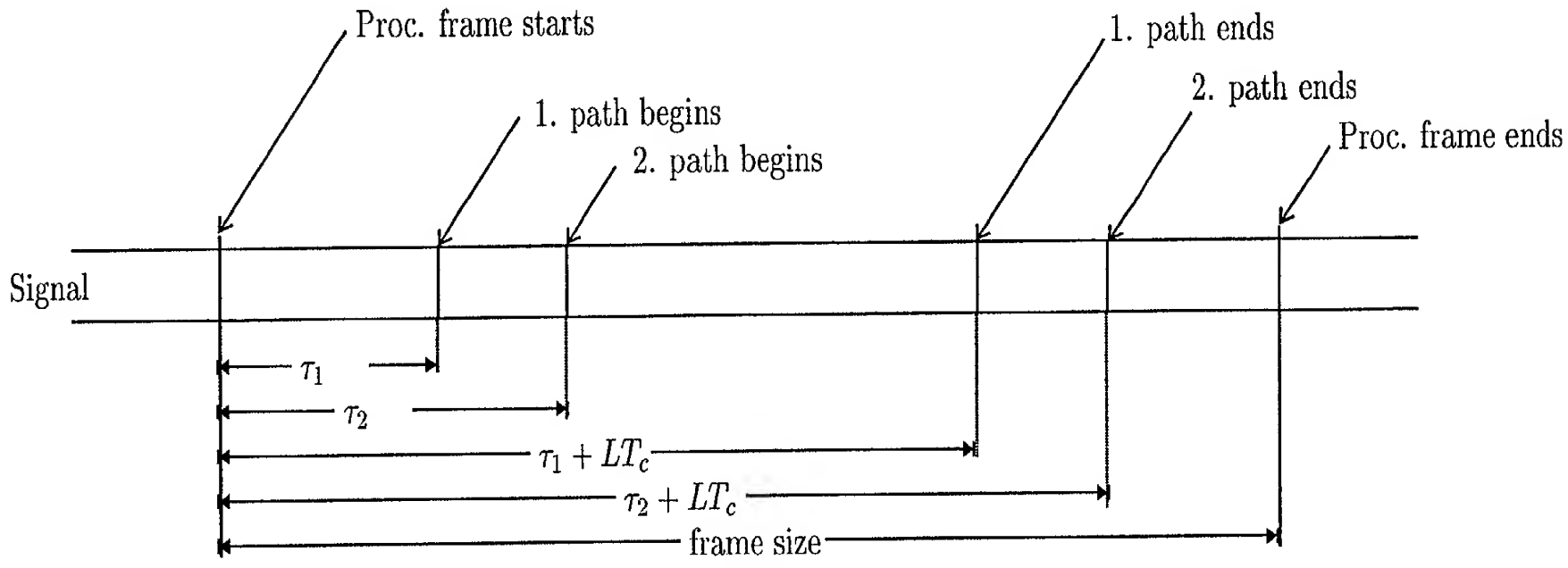

Proc. frame starts
1. path begins
2. path begins
1. path ends
2. path ends
Proc. frame ends
Signal
τ_1
τ_2
$\tau_1 + LT_c$
$\tau_2 + LT_c$
frame size

FIG. 32

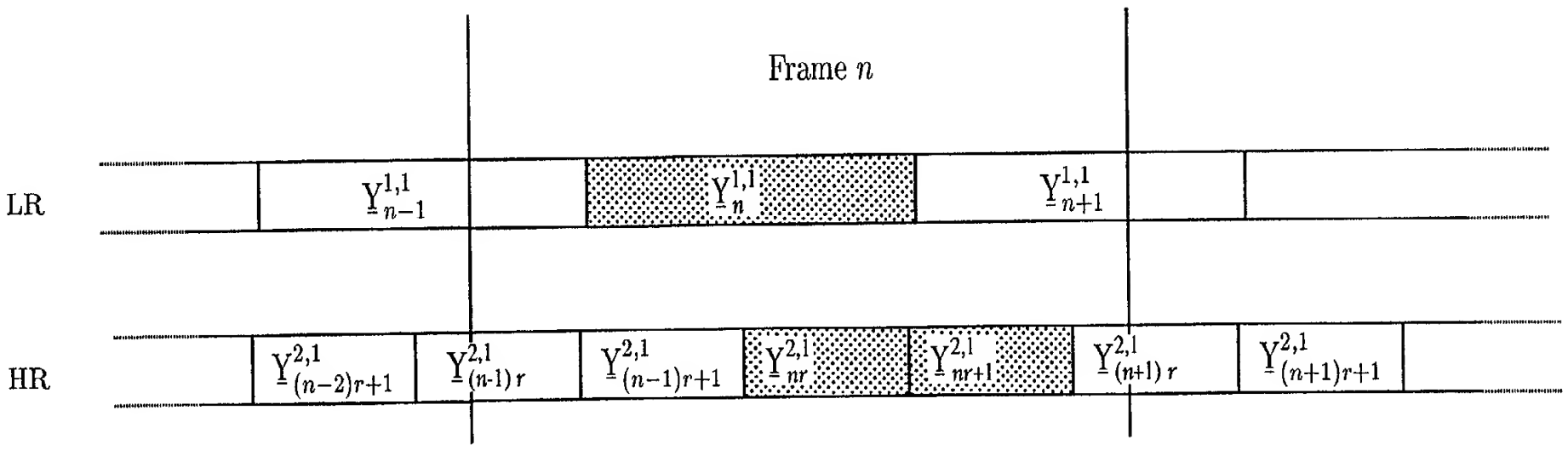

Frame n
LR
HR
$Y^{1,1}_{n-1}$
$Y^{1,1}_{n}$
$Y^{1,1}_{n+1}$
$Y^{2,1}_{(n-2)r+1}$
$Y^{2,1}_{(n-1)r}$
$Y^{2,1}_{(n-1)r+1}$
$Y^{2,1}_{nr}$
$Y^{2,1}_{nr+1}$
$Y^{2,1}_{(n+1)r}$
$Y^{2,1}_{(n+1)r+1}$

FIG. 33

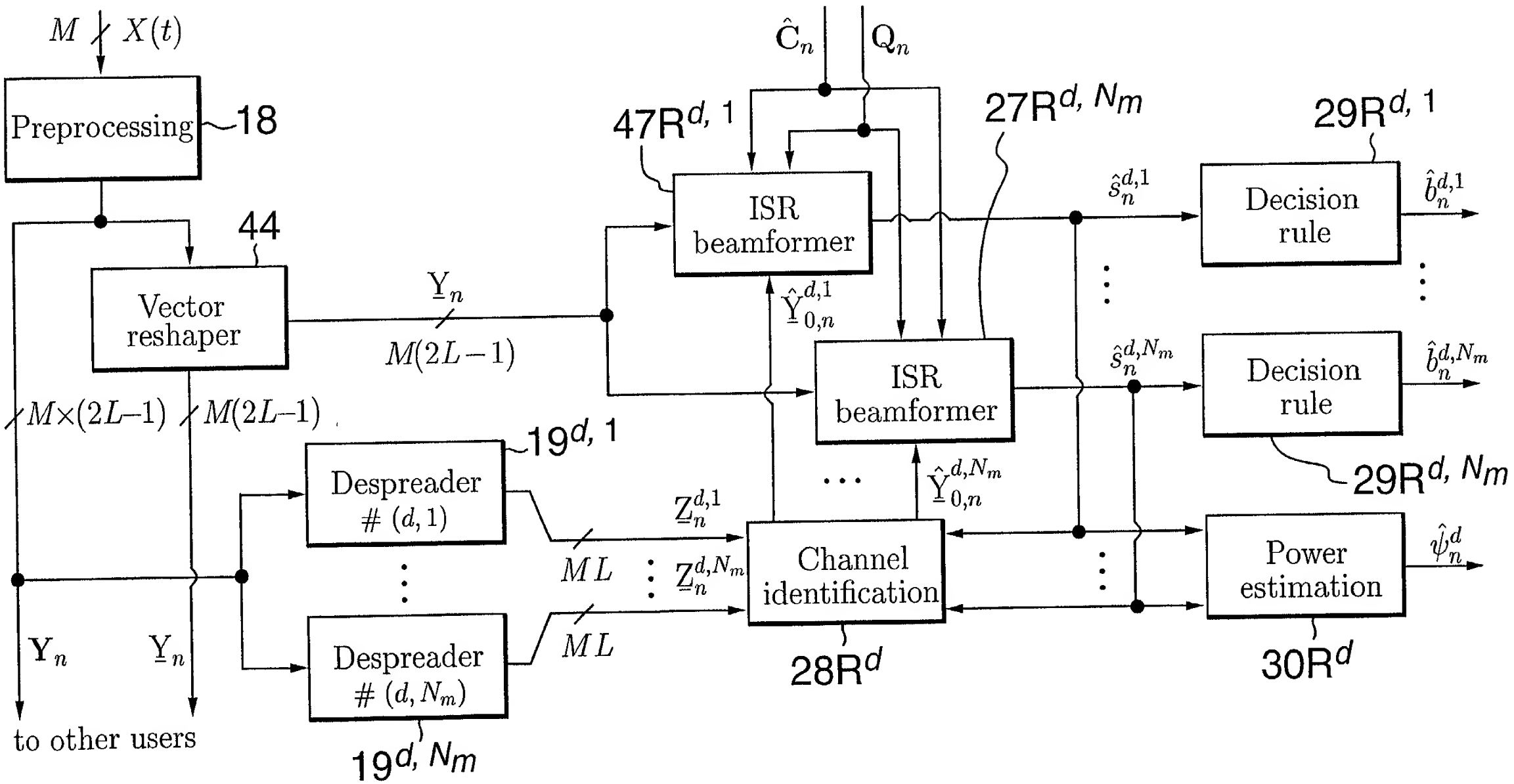

M X(t)
Preprocessing
18
44
Vector reshaper
M×(2L–1)
M(2L–1)
Y_n
M(2L–1)
Y_n
Y_n
to other users
19^d, 1
Despreader # (d, 1)
Despreader # (d, N_m)
19^d, N_m
ML
ML
Z_n^{d,1}
Z_n^{d,N_m}
Ĉ_n
Q_n
47R^d, 1
ISR beamformer
ISR beamformer
Ŷ_{0,n}^{d,1}
Ŷ_{0,n}^{d,N_m}
27R^d, Nm
Channel identification
28R^d
ŝ_n^{d,1}
ŝ_n^{d,N_m}
29R^d, 1
Decision rule
Decision rule
b̂_n^{d,1}
b̂_n^{d,N_m}
29R^d, Nm
Power estimation
30R^d
ψ̂_n^d

FIG. 34

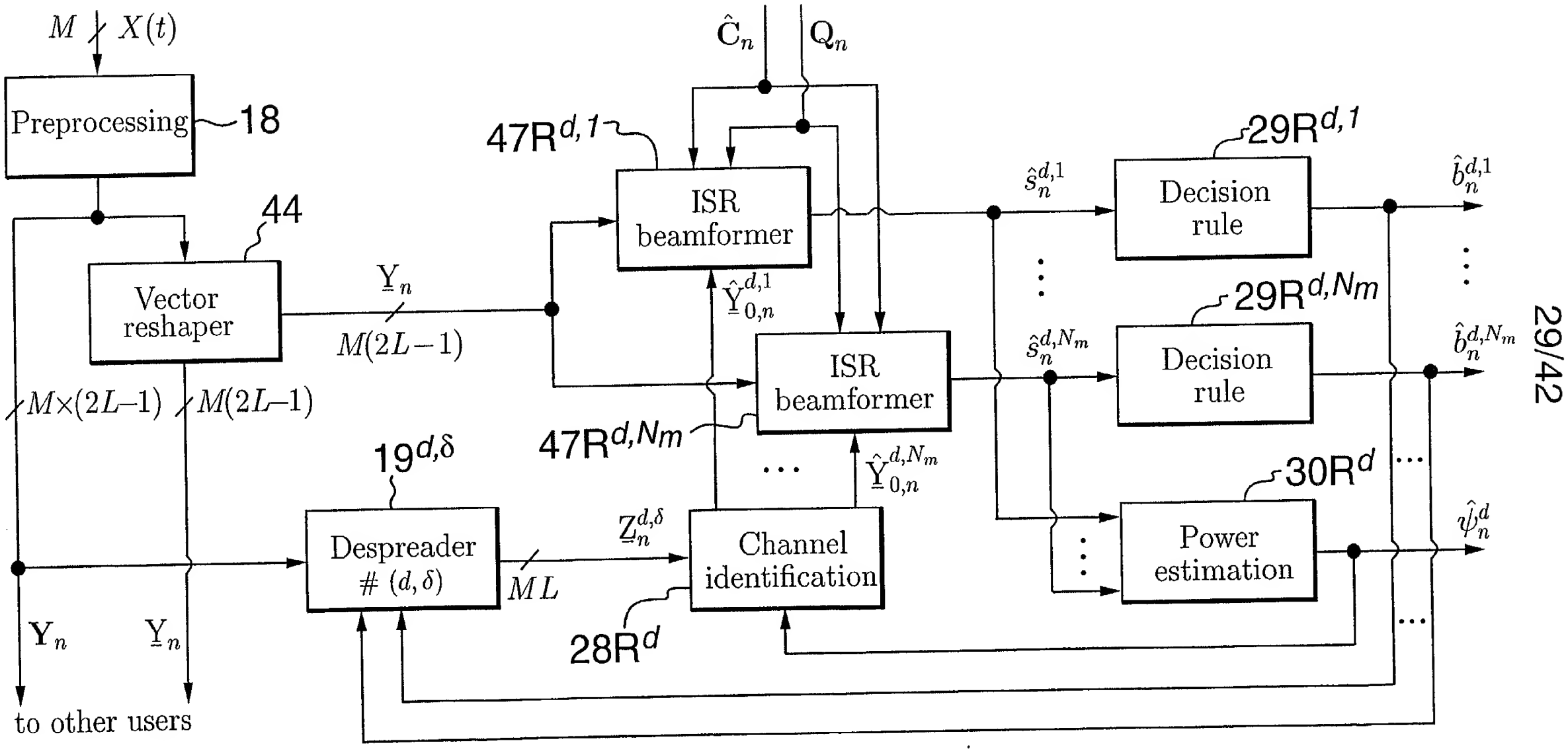

M $X(t)$
Preprocessing
18
44
Vector reshaper
$\underline{Y}_n$
$M(2L-1)$
$M\times(2L-1)$
$M(2L-1)$
$\hat{C}_n$
Q_n
47R^{d,1}
ISR beamformer
$\hat{\underline{Y}}_{0,n}^{d,1}$
47R^{d,Nm}
ISR beamformer
$\hat{\underline{Y}}_{0,n}^{d,N_m}$
$\hat{s}_n^{d,1}$
$\hat{s}_n^{d,N_m}$
29R^{d,1}
Decision rule
29R^{d,Nm}
Decision rule
$\hat{b}_n^{d,1}$
$\hat{b}_n^{d,N_m}$
19$^{d,\delta}$
Despreader # (d,δ)
$\underline{Z}_n^{d,\delta}$
ML
Channel identification
28R^d
30R^d
Power estimation
$\hat{\psi}_n^d$
$\mathbf{Y}_n$
$\underline{Y}_n$
to other users

FIG. 35

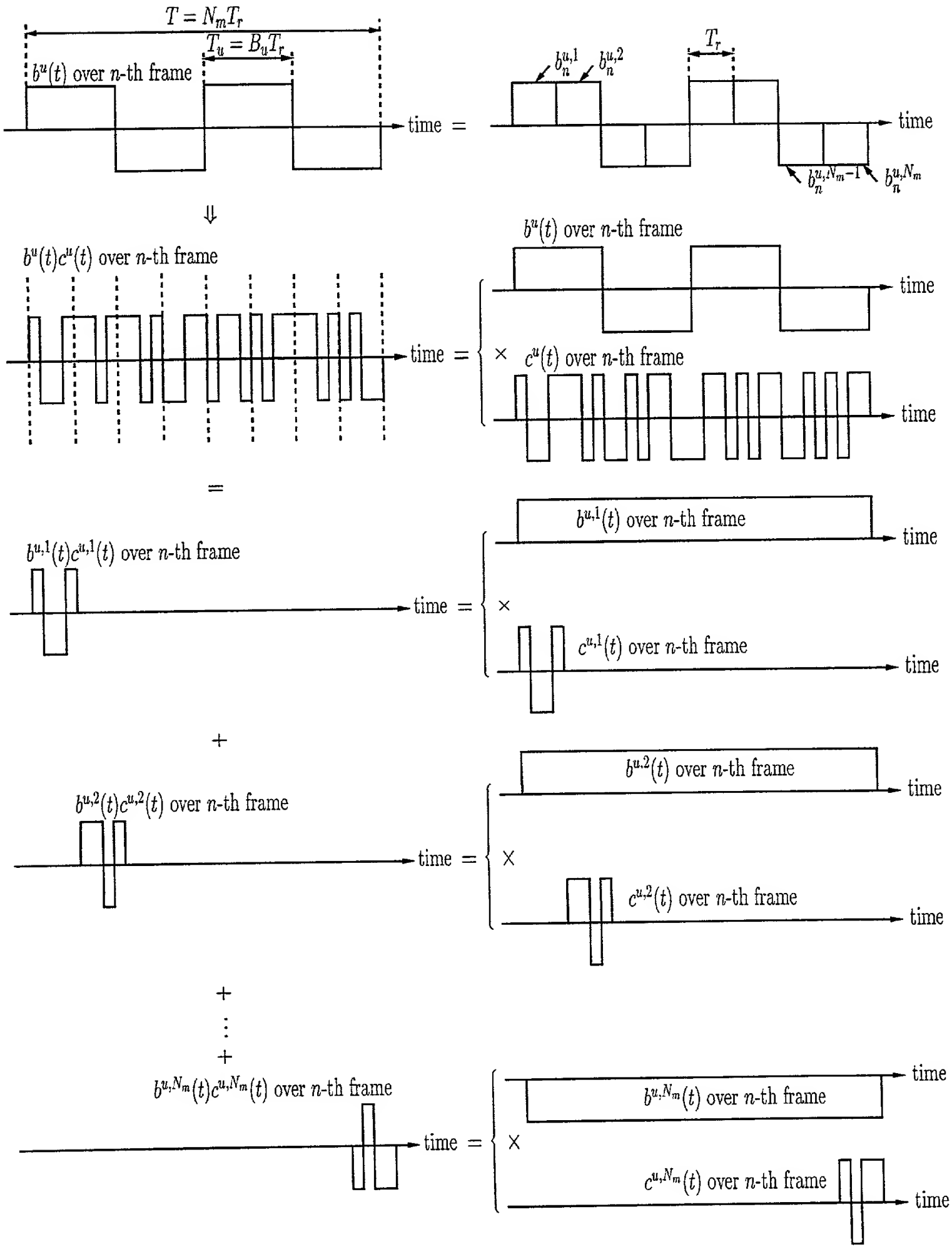

$T = N_m T_r$
$T_u = B_u T_r$
$b^u(t)$ over n-th frame
time =
T_r
$b_n^{u,1}$ $b_n^{u,2}$
b_n^{u,N_m-1} b_n^{u,N_m}
time
$b^u(t)c^u(t)$ over n-th frame
time =
$b^u(t)$ over n-th frame
time
×
$c^u(t)$ over n-th frame
time
=
$b^{u,1}(t)c^{u,1}(t)$ over n-th frame
time =
$b^{u,1}(t)$ over n-th frame
time
×
$c^{u,1}(t)$ over n-th frame
time
+
$b^{u,2}(t)c^{u,2}(t)$ over n-th frame
time =
$b^{u,2}(t)$ over n-th frame
time
×
$c^{u,2}(t)$ over n-th frame
time
+
⋮
+
$b^{u,N_m}(t)c^{u,N_m}(t)$ over n-th frame
time =
time
$b^{u,N_m}(t)$ over n-th frame
×
$c^{u,N_m}(t)$ over n-th frame
time

FIG. 36

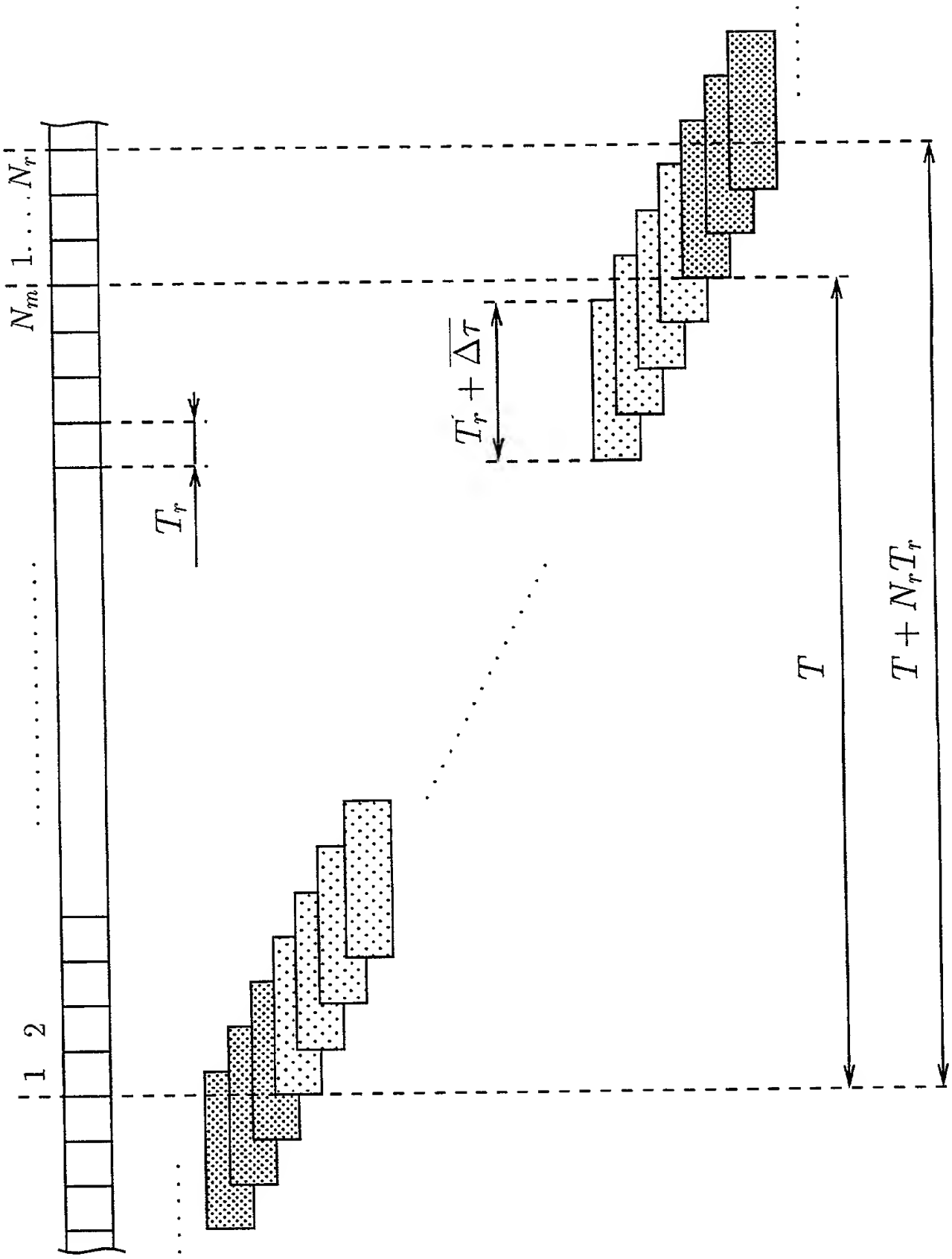


FIG. 37

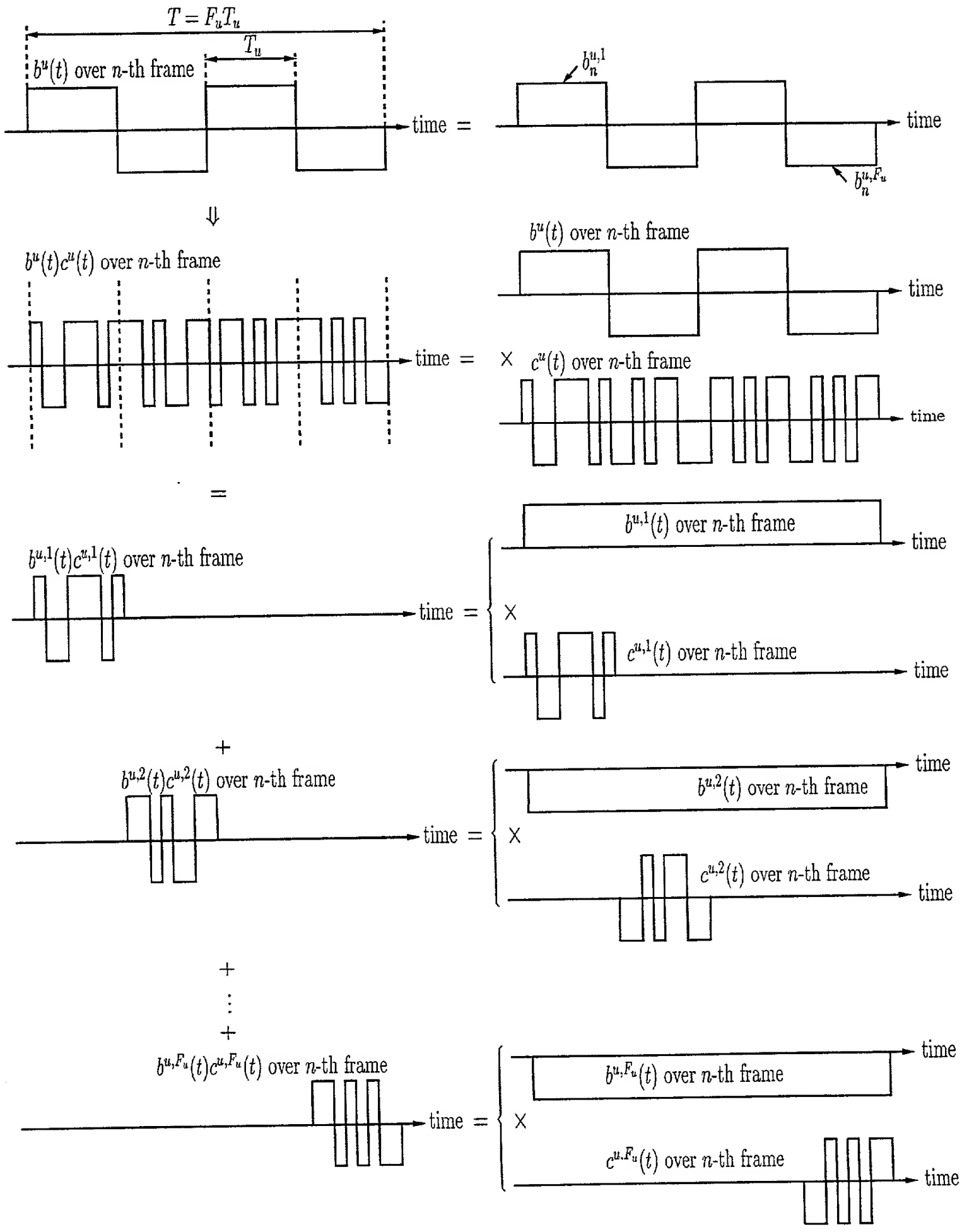

$T = F_u T_u$
T_u
$b^u(t)$ over n-th frame
time
=
$b_n^{u,1}$
b_n^{u,F_u}
$b^u(t)c^u(t)$ over n-th frame
$b^u(t)$ over n-th frame
$c^u(t)$ over n-th frame
×
$b^{u,1}(t)c^{u,1}(t)$ over n-th frame
$b^{u,1}(t)$ over n-th frame
$c^{u,1}(t)$ over n-th frame
+
$b^{u,2}(t)c^{u,2}(t)$ over n-th frame
$b^{u,2}(t)$ over n-th frame
$c^{u,2}(t)$ over n-th frame
$b^{u,F_u}(t)c^{u,F_u}(t)$ over n-th frame
$b^{u,F_u}(t)$ over n-th frame
$c^{u,F_u}(t)$ over n-th frame

FIG. 38

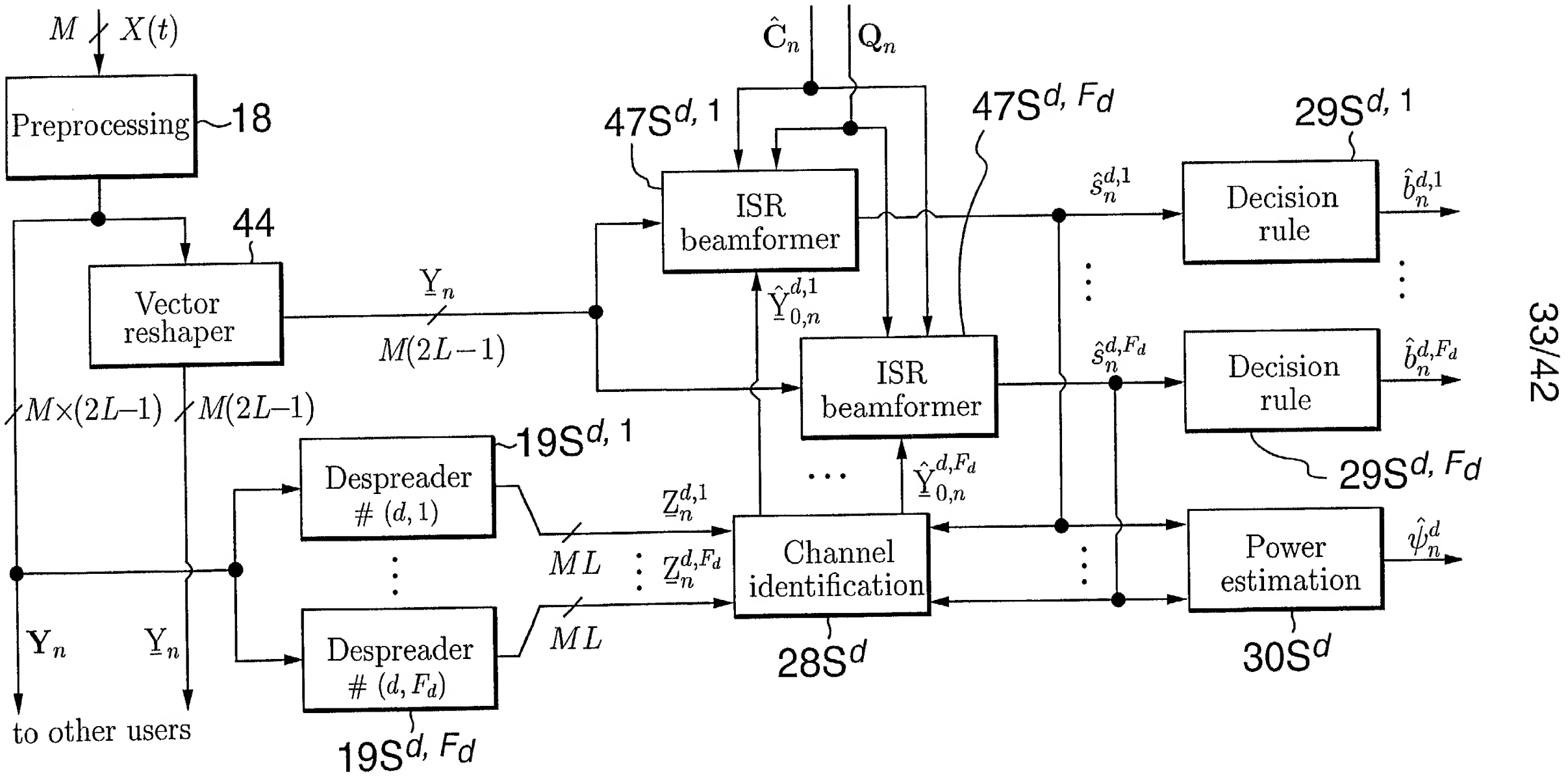

M X(t)
Preprocessing
18
44
Vector reshaper
M×(2L–1)
M(2L–1)
Y_n
M(2L–1)
Y_n
Y_n
to other users
Despreader # (d, 1)
19S^d, 1
Despreader # (d, F_d)
19S^d, Fd
ML
ML
Z_n^{d,1}
Z_n^{d,F_d}
Ĉ_n
Q_n
47S^d, 1
47S^d, Fd
ISR beamformer
ISR beamformer
Ŷ_{0,n}^{d,1}
Ŷ_{0,n}^{d,F_d}
ŝ_n^{d,1}
ŝ_n^{d,F_d}
Decision rule
Decision rule
29S^d, 1
29S^d, Fd
b̂_n^{d,1}
b̂_n^{d,F_d}
Channel identification
28S^d
Power estimation
30S^d
ψ̂_n^d

FIG. 39

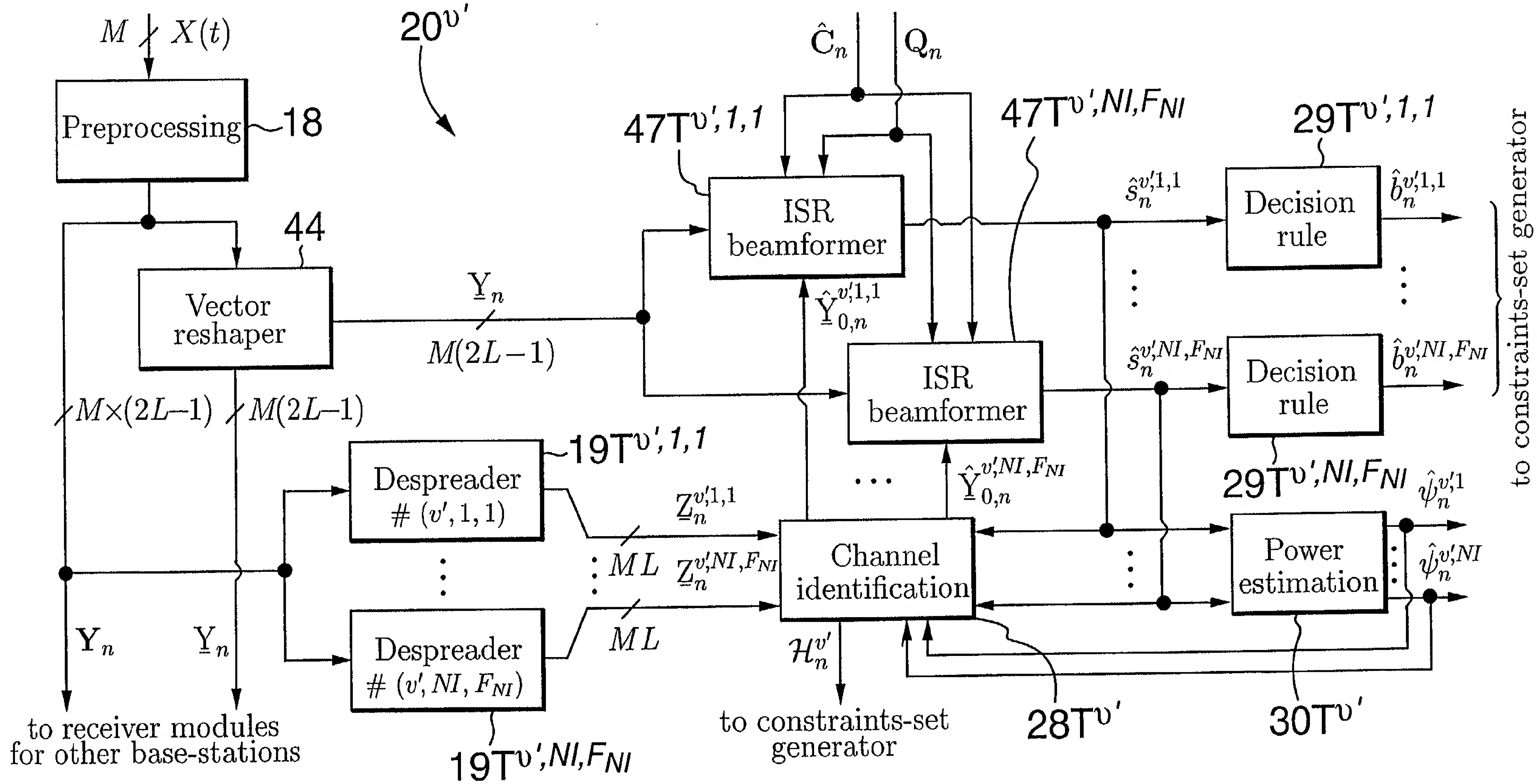

M X(t)
20υ'
Preprocessing
18
44
Vector reshaper
Y_n
M(2L−1)
M×(2L–1)
M(2L–1)
$\hat{C}_n$
Q_n
47Tυ',1,1
47Tυ',NI,F_NI
ISR beamformer
ISR beamformer
$\hat{Y}_{0,n}^{v',1,1}$
$\hat{Y}_{0,n}^{v',NI,F_{NI}}$
$\hat{s}_n^{v',1,1}$
$\hat{s}_n^{v',NI,F_{NI}}$
29Tυ',1,1
29Tυ',NI,F_NI
Decision rule
Decision rule
$\hat{b}_n^{v',1,1}$
$\hat{b}_n^{v',NI,F_{NI}}$
to constraints-set generator
19Tυ',1,1
19Tυ',NI,F_NI
Despreader # (v', 1, 1)
Despreader # (v', NI, F_NI)
ML
ML
$Z_n^{v',1,1}$
$Z_n^{v',NI,F_{NI}}$
Channel identification
$\mathcal{H}_n^{v'}$
to constraints-set generator
28Tυ'
Power estimation
$\hat{\psi}_n^{v',1}$
$\hat{\psi}_n^{v',NI}$
30Tυ'
Y_n
Y_n
to receiver modules for other base-stations

FIG. 40

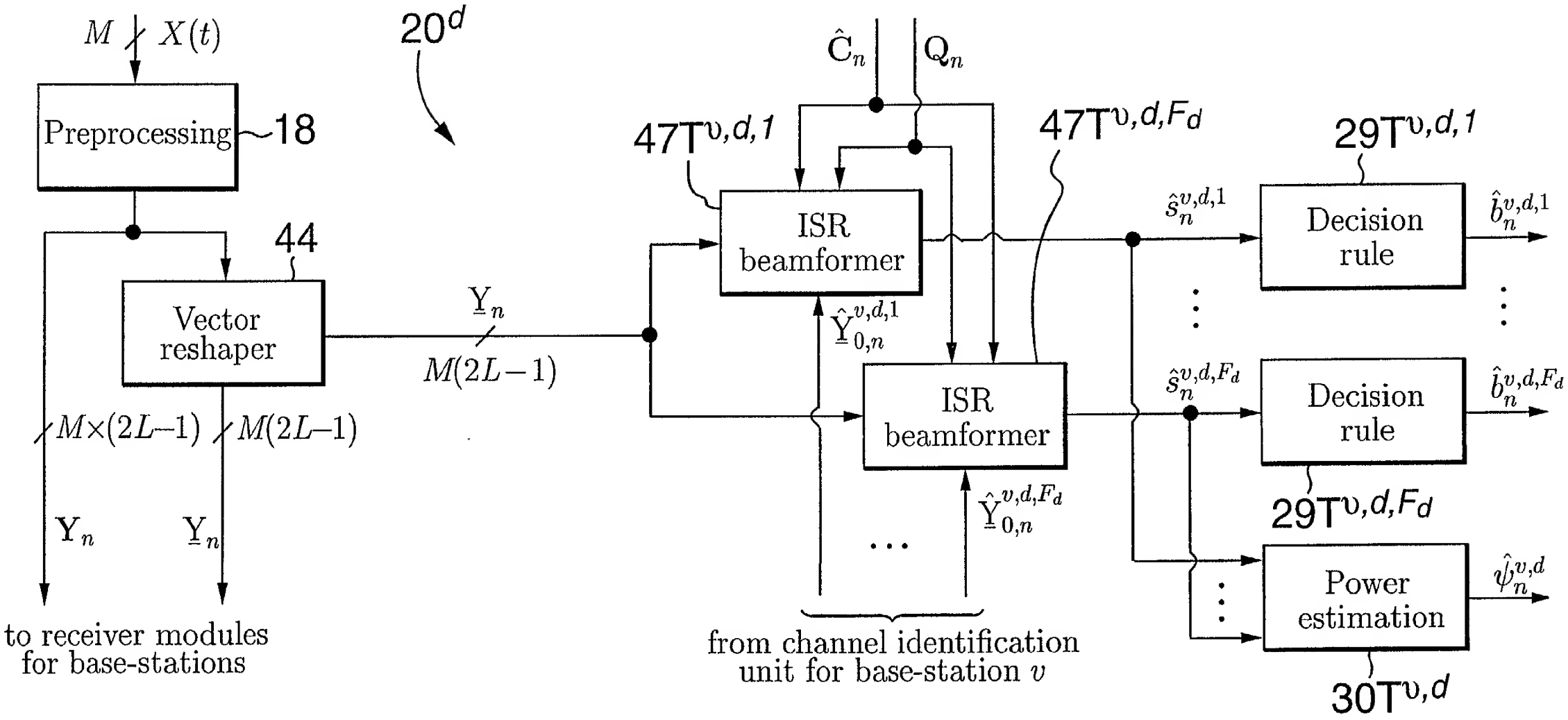

M X(t)
Preprocessing
18
20d
44
Vector reshaper
M×(2L–1)
M(2L–1)
Y_n
Y_n
to receiver modules for base-stations
Ĉ_n
Q_n
47T^υ,d,1
47T^υ,d,Fd
ISR beamformer
ISR beamformer
Ŷ^v,d,1_0,n
Ŷ^v,d,Fd_0,n
Y_n
M(2L–1)
from channel identification unit for base-station v
ŝ^v,d,1_n
ŝ^v,d,Fd_n
29T^υ,d,1
Decision rule
Decision rule
29T^υ,d,Fd
b̂^v,d,1_n
b̂^v,d,Fd_n
Power estimation
30T^υ,d
ψ̂^v,d_n

FIG. 41

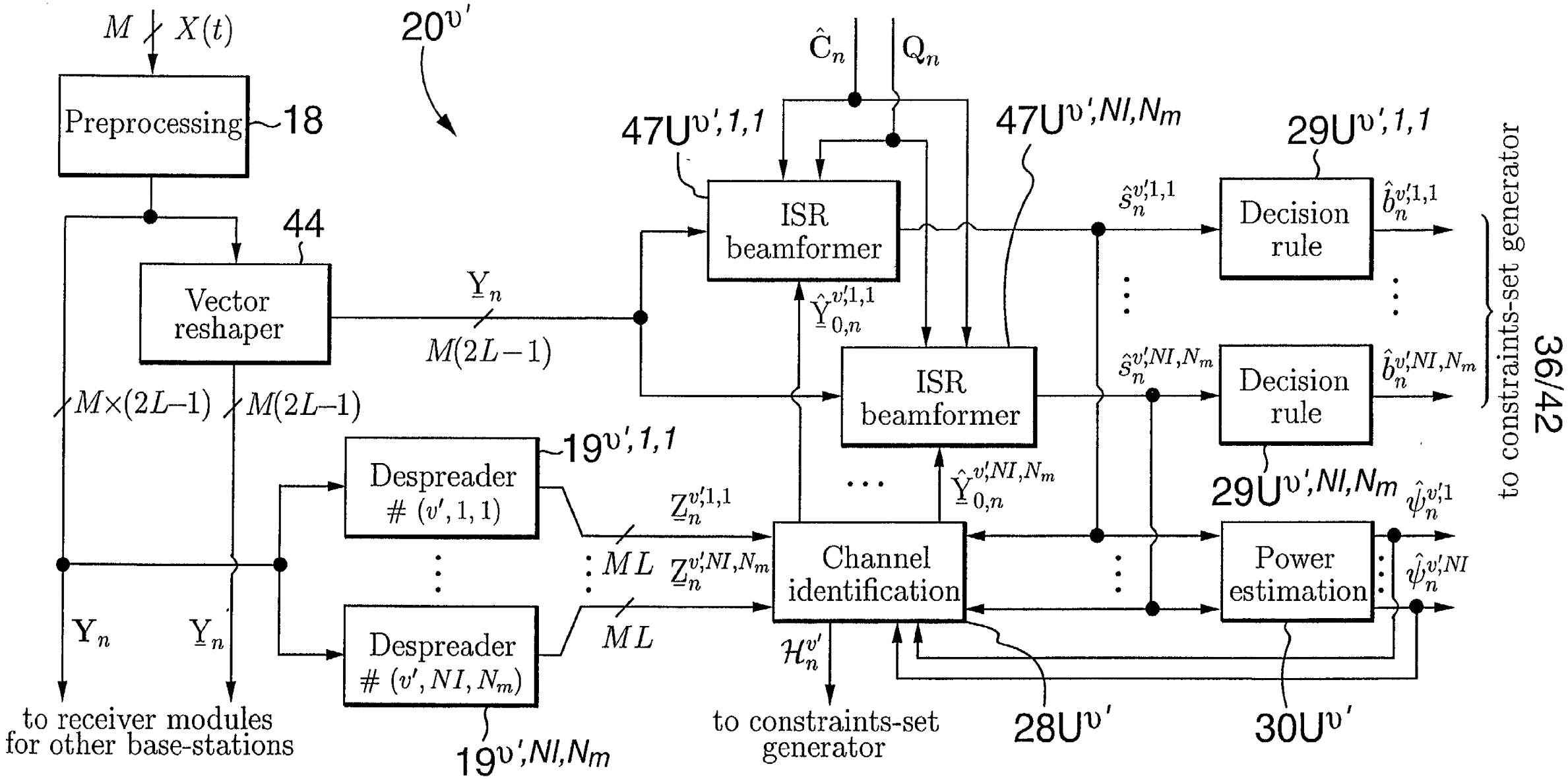

M ⧸ X(t)
Preprocessing
18
20υ'
Ĉn
Qn
47Uυ',1,1
47Uυ',NI,Nm
29Uυ',1,1
44
Vector reshaper
Yn
M(2L−1)
ISR beamformer
ISR beamformer
M×(2L−1)
M(2L−1)
19υ',1,1
Despreader # (υ', 1, 1)
Despreader # (υ', NI, Nm)
19υ',NI,Nm
ML
Channel identification
Power estimation
Decision rule
Decision rule
29Uυ',NI,Nm
28Uυ'
30Uυ'
to receiver modules for other base-stations
to constraints-set generator
to constraints-set generator

FIG. 42

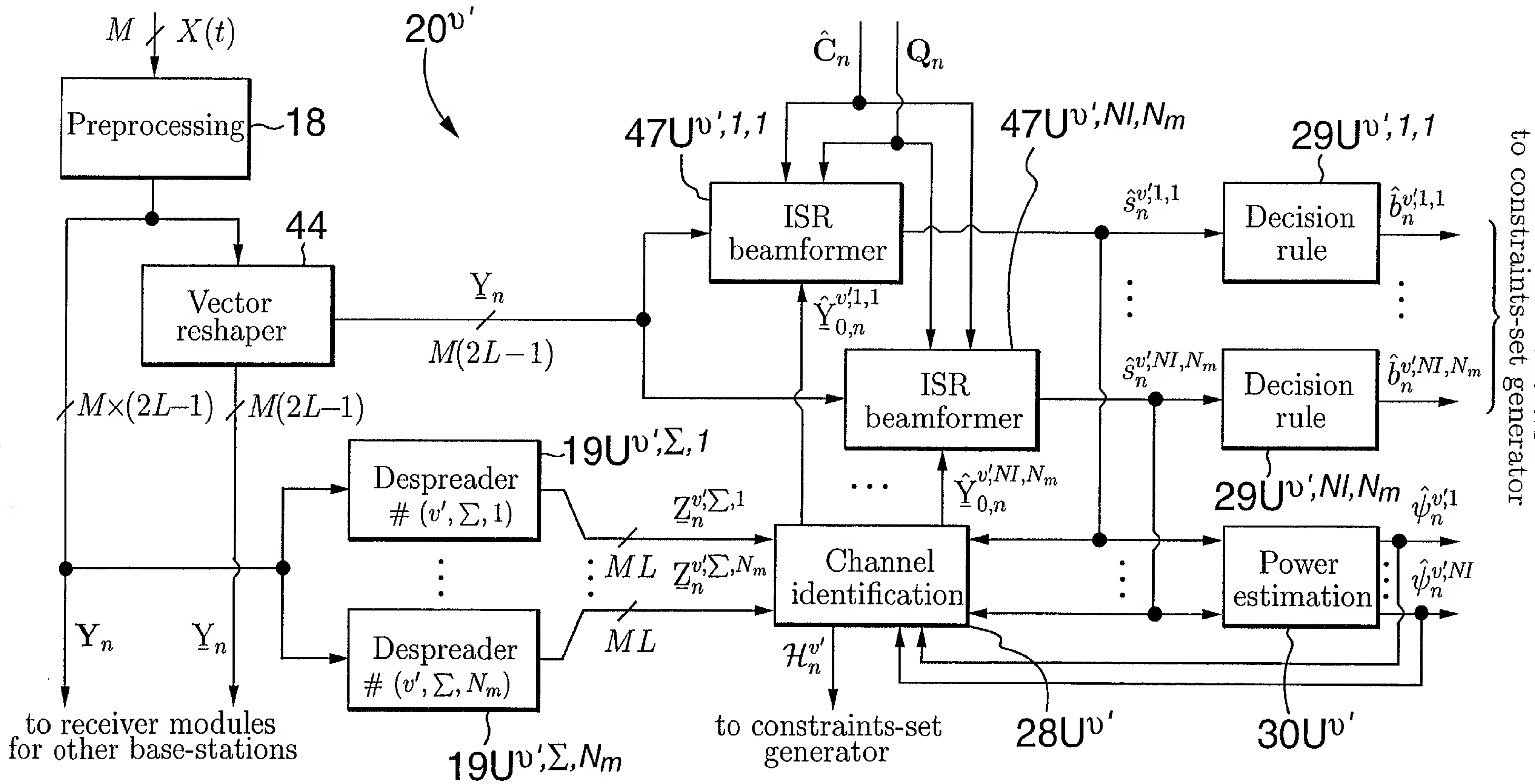

M
X(t)
Preprocessing
18
20υ'
Vector reshaper
44
Y_n
M(2L−1)
M×(2L–1)
M(2L–1)
Ĉ_n
Q_n
47Uυ',1,1
ISR beamformer
47Uυ',NI,Nm
ISR beamformer
Decision rule
29Uυ',1,1
Decision rule
29Uυ',NI,Nm
Despreader # (v', Σ, 1)
19Uυ',Σ,1
Despreader # (v', Σ, N_m)
19Uυ',Σ,Nm
ML
ML
Channel identification
Power estimation
28Uυ'
30Uυ'
Y_n
Y_n
to receiver modules for other base-stations
to constraints-set generator
to constraints-set generator

FIG. 43

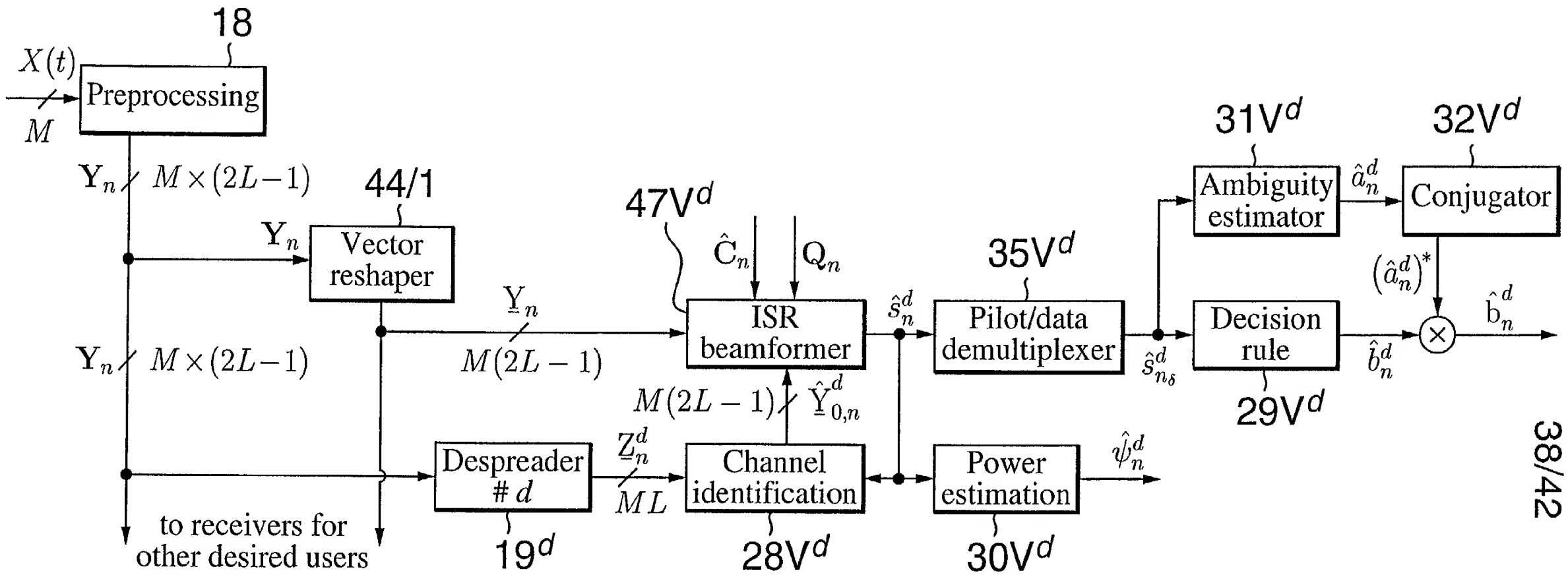

18
$X(t)$
M
Preprocessing
$\mathbf{Y}_n$
$M \times (2L-1)$
44/1
$\mathbf{Y}_n$
Vector reshaper
$\mathbf{Y}_n$
$M \times (2L-1)$
$\underline{Y}_n$
$M(2L-1)$
47V^d
$\hat{C}_n$
Q_n
ISR beamformer
$\hat{s}_n^d$
35V^d
Pilot/data demultiplexer
$\hat{s}_{n_\delta}^d$
31V^d
Ambiguity estimator
$\hat{a}_n^d$
32V^d
Conjugator
$(\hat{a}_n^d)^*$
Decision rule
$\hat{b}_n^d$
$\hat{b}_n^d$
29V^d
$M(2L-1)$
$\hat{\underline{Y}}_{0,n}^d$
Despreader # d
$\underline{Z}_n^d$
ML
Channel identification
28V^d
Power estimation
$\hat{\psi}_n^d$
30V^d
19^d
to receivers for other desired users

FIG. 44

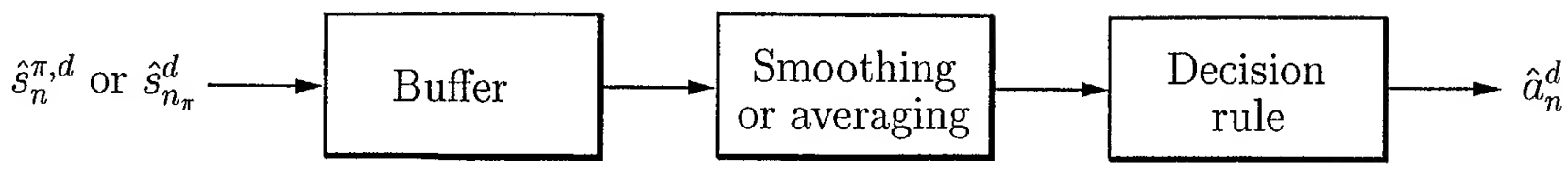

$\hat{s}_n^{\pi,d}$ or $\hat{s}_{n_\pi}^d$
Buffer
Smoothing or averaging
Decision rule
$\hat{a}_n^d$

FIG. 45

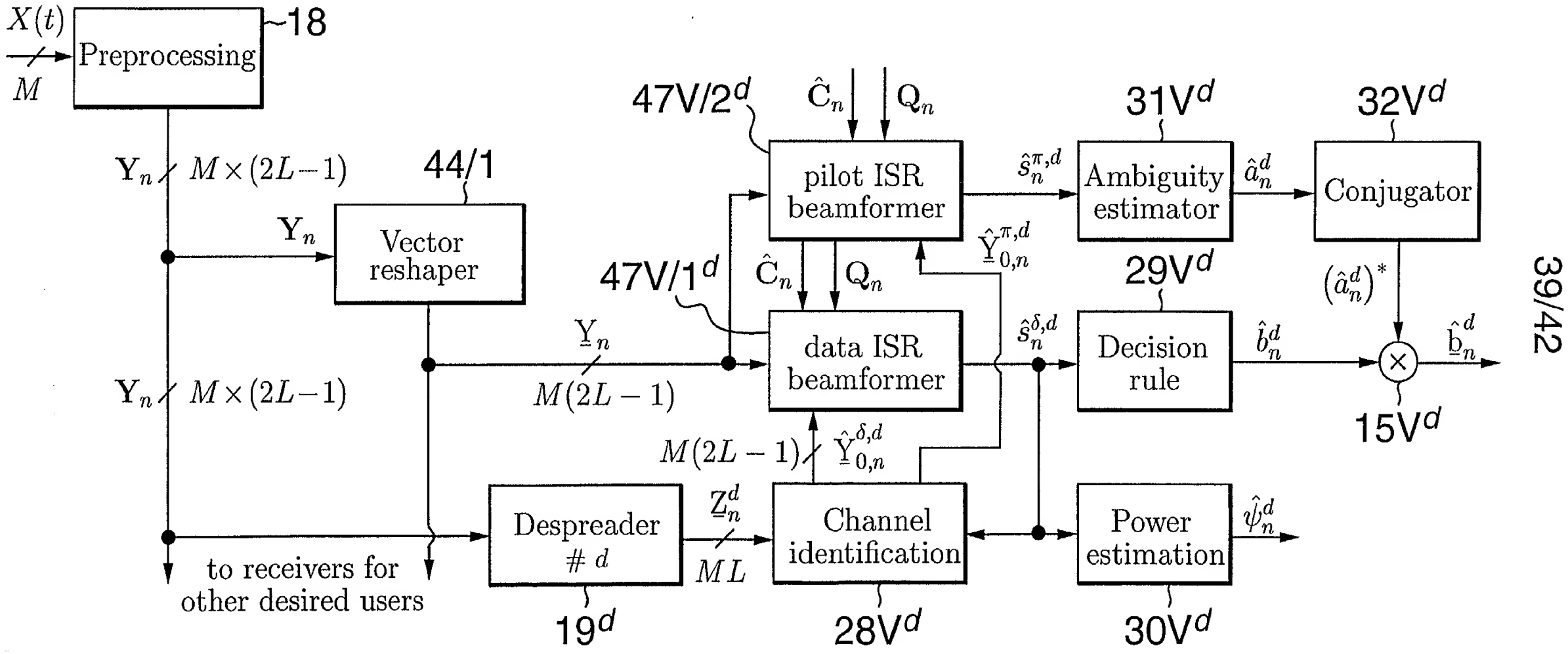

X(t)
M
Preprocessing
18
Y_n
M × (2L−1)
44/1
Y_n
Vector reshaper
47V/2^d
Ĉ_n
Q_n
pilot ISR beamformer
ŝ_n^{π,d}
31V^d
Ambiguity estimator
â_n^d
32V^d
Conjugator
Ŷ_{0,n}^{π,d}
47V/1^d
Ĉ_n
Q_n
29V^d
(â_n^d)*
Y_n
M(2L − 1)
data ISR beamformer
ŝ_n^{δ,d}
Decision rule
b̂_n^d
b̂_n^d
15V^d
Y_n
M × (2L−1)
M(2L − 1)
Ŷ_{0,n}^{δ,d}
Despreader # d
Z_n^d
ML
Channel identification
Power estimation
ψ̂_n^d
to receivers for other desired users
19^d
28V^d
30V^d

FIG. 46

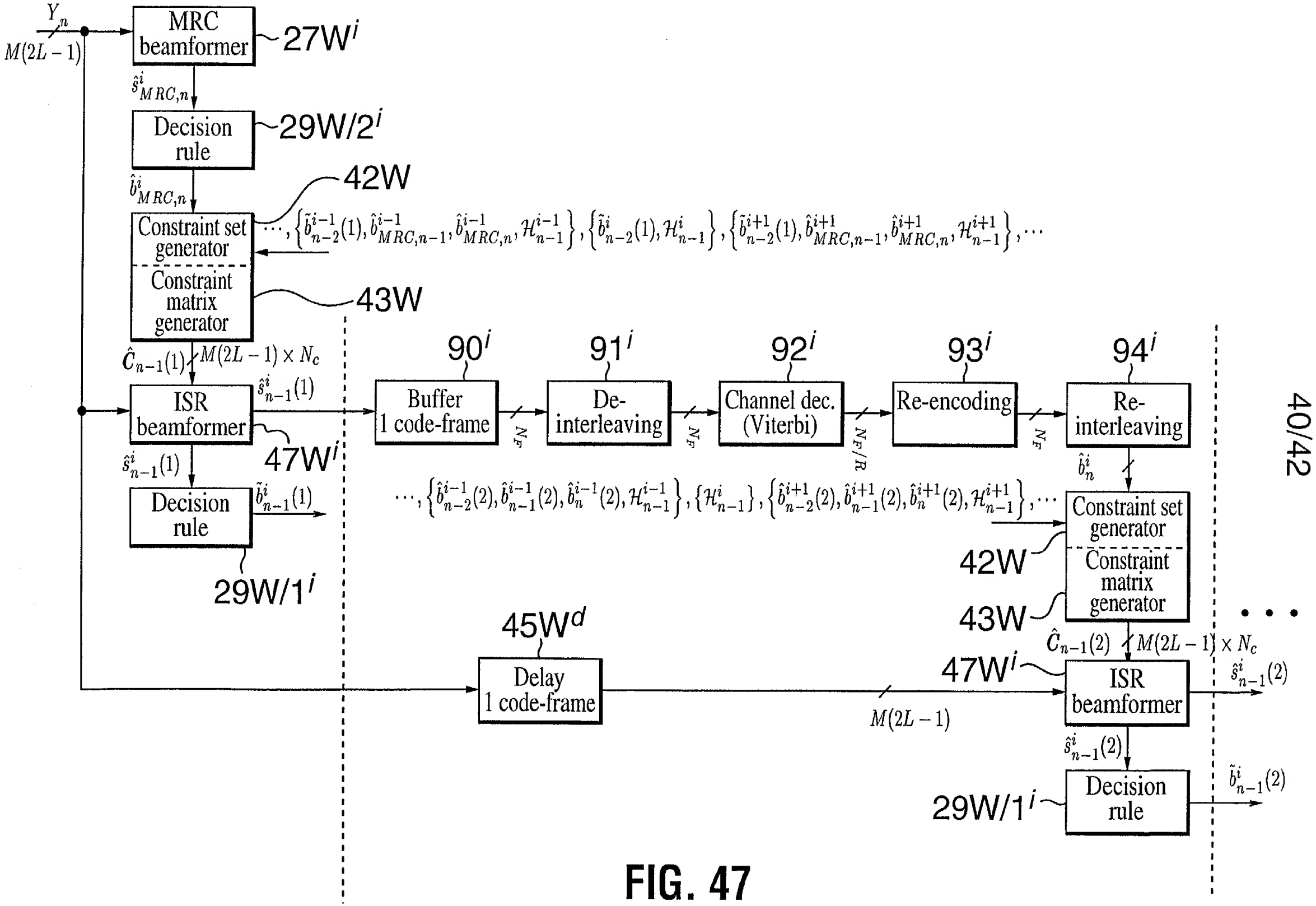

Y_n
$M(2L-1)$
MRC beamformer
27W^i
$\hat{s}^i_{MRC,n}$
Decision rule
29W/2^i
$\hat{b}^i_{MRC,n}$
Constraint set generator
Constraint matrix generator
42W
43W
$\cdots, \left\{\tilde{b}^{i-1}_{n-2}(1), \hat{b}^{i-1}_{MRC,n-1}, \hat{b}^{i-1}_{MRC,n}, \mathcal{H}^{i-1}_{n-1}\right\}, \left\{\tilde{b}^{i}_{n-2}(1), \mathcal{H}^{i}_{n-1}\right\}, \left\{\tilde{b}^{i+1}_{n-2}(1), \hat{b}^{i+1}_{MRC,n-1}, \hat{b}^{i+1}_{MRC,n}, \mathcal{H}^{i+1}_{n-1}\right\}, \cdots$
$\hat{C}_{n-1}(1)$
$M(2L-1) \times N_c$
ISR beamformer
47W^i
$\hat{s}^i_{n-1}(1)$
Decision rule
29W/1^i
$\tilde{b}^i_{n-1}(1)$
90^i
Buffer 1 code-frame
91^i
De-interleaving
92^i
Channel dec. (Viterbi)
93^i
Re-encoding
94^i
Re-interleaving
N_F
N_F/R
$\hat{b}^i_n$
$\cdots, \left\{\hat{b}^{i-1}_{n-2}(2), \hat{b}^{i-1}_{n-1}(2), \hat{b}^{i-1}_{n}(2), \mathcal{H}^{i-1}_{n-1}\right\}, \left\{\mathcal{H}^{i}_{n-1}\right\}, \left\{\hat{b}^{i+1}_{n-2}(2), \hat{b}^{i+1}_{n-1}(2), \hat{b}^{i+1}_{n}(2), \mathcal{H}^{i+1}_{n-1}\right\}, \cdots$
Constraint set generator
Constraint matrix generator
42W
43W
$\hat{C}_{n-1}(2)$
$M(2L-1) \times N_c$
47W^i
ISR beamformer
$\hat{s}^i_{n-1}(2)$
$\hat{s}^i_{n-1}(2)$
Decision rule
29W/1^i
$\tilde{b}^i_{n-1}(2)$
45W^d
Delay 1 code-frame
$M(2L-1)$

FIG. 47

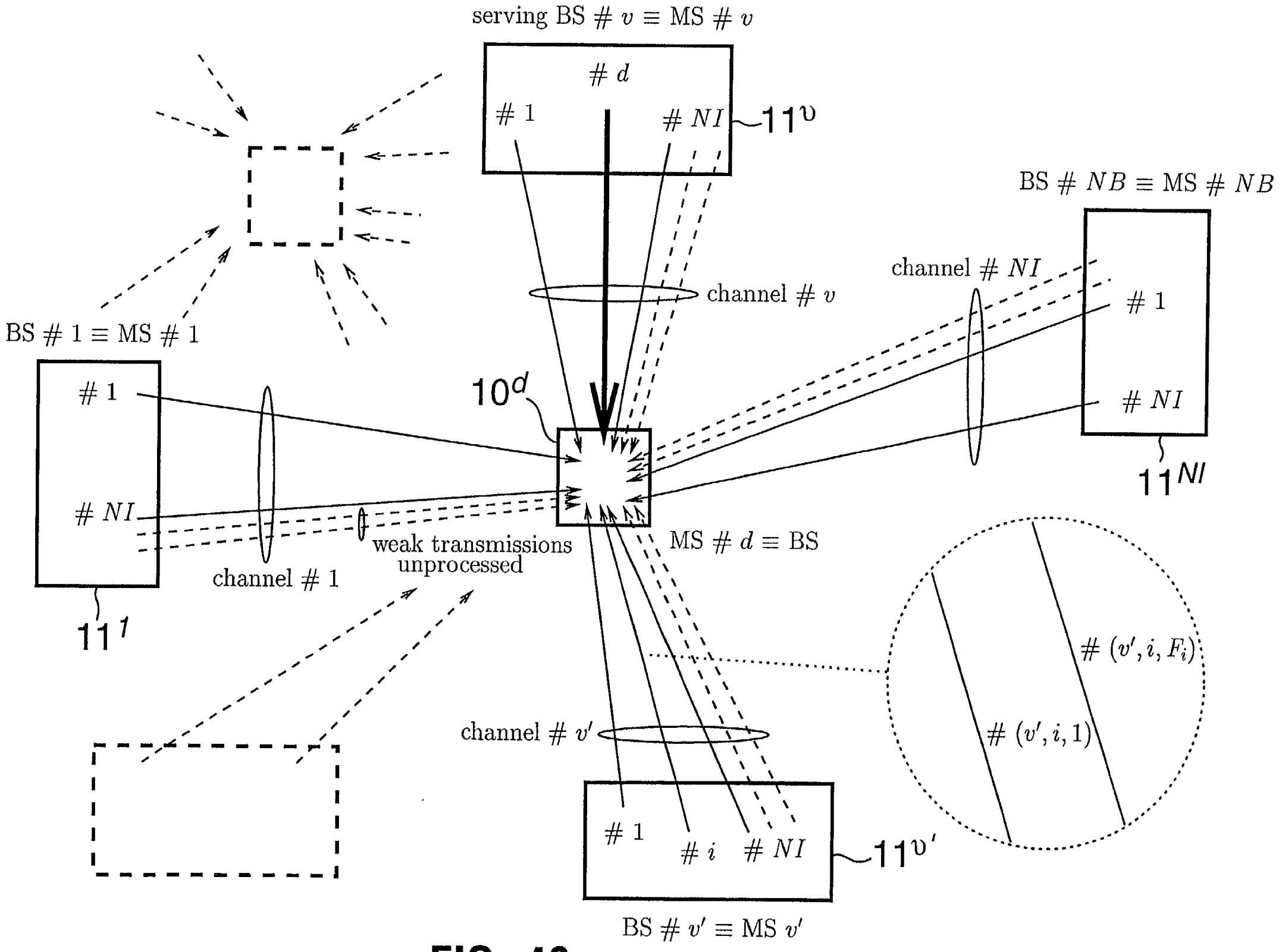

serving BS # $v \equiv$ MS # v
d
1
NI
11^{υ}
BS # $NB \equiv$ MS # NB
channel # NI
1
NI
11^{NI}
channel # v
BS # 1 ≡ MS # 1
1
NI
10^{d}
weak transmissions unprocessed
MS # $d \equiv$ BS
channel # 1
11^{1}
(v', i, F_i)
$(v', i, 1)$
channel # v'
1
i
NI
$11^{\upsilon'}$
BS # $v' \equiv$ MS v'

FIG. 48

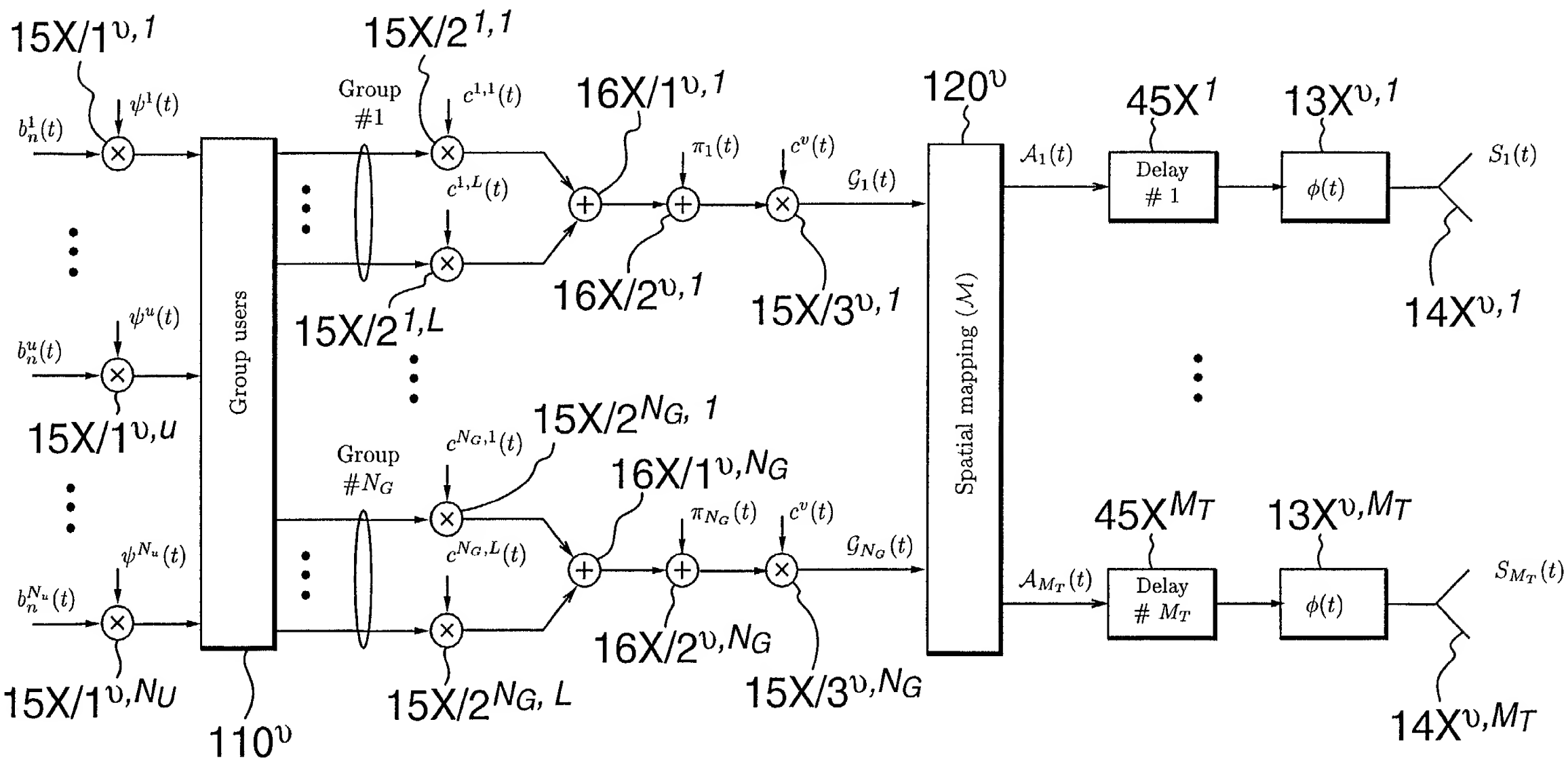

15X/1υ,1
15X/2 1,1
Group #1
16X/1υ,1
120υ
45X1
13Xυ,1
Delay # 1
φ(t)
14Xυ,1
Group users
Spatial mapping (M)
15X/2 1,L
16X/2υ,1
15X/3υ,1
15X/1υ,u
15X/2NG, 1
Group #NG
16X/1υ,NG
45XMT
13Xυ,MT
Delay # MT
14Xυ,MT
16X/2υ,NG
15X/3υ,NG
15X/1υ,NU
15X/2NG, L
110υ

FIG. 49